BULLETIN

OF THE

American Geographical Society.

Vol. XXXIV **1902.** **No. 1**

RECENT WORK OF THE U. S. GEOLOGICAL SURVEY IN ALASKA.

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In keeping with the annual appropriations made by the Congress for the purpose, the work of the U. S. Geological Survey in Alaska, begun in 1895, has been vigorously prosecuted up to the present time. Though the results of each season's work have appeared almost immediately in the published reports and maps of the bureau, the rapid growth of the country and the development of various mining regions with reference to gold, copper, coal, and oil have rendered the demand for geographic and geologic information, in many instances, much beyond the power of the Survey with its present force to supply. During the past season, 1901, four parties were in the field, respectively in southeastern Alaska, Seward peninsula, the Kobuk river region, and northern Alaska and the Arctic coast.

Southeastern Alaska.—In the relatively well-known region of southeastern Alaska, also known as the *panhandle* of Alaska, embracing the scenic Alexander archipelago and neighbouring fiords, inlets, and peninsulas, the work was in charge of geologists Alfred H. Brooks and C. C. Brayton. Here the work was more economic, and of a less explorational and geographic character, than in the northern regions. Considerable attention was devoted to Prince of Wales Island, where the mineral deposits were visited and examined, as were also those in the Sitka, Ketchikan, Juneau, and Skagway vicinities, where development work had been done.

Seward Peninsula.—Recognition of the prospective extension of the Nome gold fields to the northward made it urgent that last year's (1900) work of the Survey* in the southern part of the peninsula should be continued as far as possible in the northern part in 1901. This work in the northern part of the peninsula, in charge of T. G. Gerdine and D. C. Witherspoon, topographers, and A. J. Collier, geologist, accordingly consisted in making a topographic and geologic survey of the western central part of the peninsula lying essentially to the north of Port Clarence, Grantley Harbour, and the Imuruk basin. The area lies between the 65th and 66th parallels, and the 164th and 168th meridians. The outline is roughly equilaterally triangular, with an apex extending westward to near Cape Prince of Wales, the most westerly point of the American continent.

Itinerary and Method of Work.—Transportation in the field was essentially by pack train, and to some extent by boat. The party and outfit destined for Port Clarence arrived in the roadstead off Nunivak Island in latitude 60° on the S.S. *Senator*, June 9, but was delayed by the pack ice in Bering Sea until June 16, when a landing was effected at Nome. Owing to the lateness of the spring, the surrounding mountains were still white, and snowdrifts were in the streets of Nome. Heavy teaming was still going on over the firm ice at Port Clarence and Grantley Harbour. Vegetation had not yet started. Not until July 12 could the season's field work be begun at Teller City, near the entrance to Grantley Harbour, where the signals erected by the U. S. Coast and Geodetic Survey were repaired, and from these, as a base, a system of triangulation was expanded over the northern part of the peninsula.

From Teller the work was carried westward to the Don Carlos river, thence northward by way of a pass at the head of this river, and around the northern side of the York mountains to York. From this point the route of work was northeastward toward Ear Mountain, then southeastward to the head of steamboat navigation on the Kuzitrin river in latitude 65° 10′, where a cache of supplies had been sent earlier in the season. From here a detachment proceeded westward to map the lower Agiapuk drainage, while the remainder of the party proceeded northward as far as Midnight Mountain, latitude 65° 48′, and thence returning southward, reached Nome September 13.

* Reconnaissances in the Cape Nome and Norton Bay Regions, Alaska, in 1900. U. S. Geological Survey.

Owing to great scarcity of grass, due to the unusual coldness of the summer, it was necessary to carry horse feed throughout the season. During the progress of the work many side trips were made by detachments, while the main camp moved slowly. In execution, the work, especially its topographic side, was much delayed by rain and fog. But the season's effort resulted in the completion of a much-needed topographic map of the region, with a contour interval of 200 feet, and covering an area of nearly 5,000 square miles; and the collection of important physiographic, economic and geologic data.

MOUNTAINS AND PLATEAU.—The Kigluaik or Sawtooth Mountains, trending east and west along the southeastern edge of the area on the 65th parallel, are the highest mountains of Seward peninsula, attaining an elevation of 4,700 feet. This mountain axis is continued eastward in the Bendeleben range, which rises to a height of 3,700 feet at its highest point. North of this mountain axis the upland surface in general has the character of a warped and dissected plateau, whose middle portion has a maximum elevation of about 1,500 feet, whence the sloping surface at some points along the northern and southern margins descends to sea-level. Upon this plateau occur a number of mountains and buttes, with no definite system of arrangement. The most prominent of these are the York Mountains, consisting of an approximately circular, rugged group, covering an area of nearly 100 square miles, the highest point of which rises to about 3,000 feet. These buttes and mountains are of the Monadnock type, the most prominent being Mounts Mukacharni, Cape, Conical, Kugrug, Midnight, and Devil, attaining elevations of from 1,200 to 3,000 feet. Some of these were approximately located and named on Capt. Beechey's chart of 1826.

COASTLINE—COASTAL AND LACUSTRINE PLAINS.—On the north the upland merges with a broad coastal plain, which is bordered by extensive tidal lagoons, enclosed by wave-built barrier beaches. On the south, for twenty miles eastward from Cape Prince of Wales, the plateau is bounded by steep slopes and sea-cliffs, while farther eastward the surface slopes gently to tide-level, merging with the alluvial and lacustrine plains of the Imuruk and Kuzitrin basins. Imuruk Bay, or Salt Lake, as it is locally called, occupies a broad depression on the north side of the Kigluaik Mountains, which rise abruptly from its edge. The Kuzitrin basin is a somewhat similar depression, having a like relation to the Bendeleben range on the south. It is filled with lacustrine deposits, through

which the Kuzitrin river extensively meanders before entering the slight cañon through which it flows on to Imuruk Bay.

Drainage.—The drainage of this area is somewhat remarkable, in that the two largest and longest rivers, the Agiapuk and the Kuzitrin—the former rising quite near the coast on the north—flow southward directly toward, instead of from, the highest mountain mass of the peninsula. Both flow into Imuruk Bay, thence through Grantley Harbour and Fort Clarence into Bering Sea. The Agiapuk has a drainage of nearly 800 square miles and the Kuzitrin approximately 1,200. East of the York Mountains a number of small streams flow southward into Port Clarence, while to the west of the same other shorter drainages flow southward into Bering Sea.

Heading against the Kuzitrin drainage on the north, in the northeast part of the area, the Serpentine river flows northward into Shishmaref Inlet. The remainder of the drainages, mostly flowing northwestward into the Arctic Ocean, are, in general, short. The Kuzitrin, Agiapuk, and Serpentine rivers are navigable for small river steamers for a few miles above the mouth. All are used by rowboats for the transportation of supplies.

Population.—Besides the sparse native population of Eskimos, scattered along the coast and extending inland along Imuruk Bay and Kuzitrin river, the discovery of gold in nearly all parts of the area gave to the region during the summer of 1901 an additional population of nearly 3,000 whites. This consisted mostly of prospectors, miners, and trading people. Though widely spread, some of its principal centres were Teller, with a population of 2,000; Mary's Iglo, at the head of steam navigation on the Kuzitrin, 150; Candle Creek, 100; Dall Creek, 100; York, 50. Mining operations were in progress on the Kuzitrin, Agiapuk, and other drainages of the region, and much interest directed to new discoveries made to the northeastward in the Good Hope Bay country. There is a Lutheran Mission at Port Clarence and a Congregational Mission at Cape Prince of Wales. Each has a herd of 1,000 or more reindeer.

Fish and Game.—Salmon are abundant in the Imuruk drainages. Grayling and trout are also present. The principal bird is the ptarmigan. A few very wild caribou were seen in the northern part of the region.

The Kobuk River Region.—The Kobuk has a large drainage basin in northwestern Alaska above the Arctic Circle. It heads east of the 155th meridian, and, trending westward roughly along the 67th parallel, opens into Kotzebue Sound, a large arm of the

Arctic Ocean near the 162d meridian. The work here, in charge of W. C. Mendenhall, geologist, and D. L. Reaburn, topographer, besides making a reconnaissance survey through the above region, consisted also in carrying a line from the Yukon into the Koyukuk and thence into the Kobuk, the main field of work.

Itinerary and Methods of Work.—Transportation was essentially by drainage ways and by portage. On May 27 the party, consisting of seven men, proceeded from Skagway over the coast range by rail to White Horse, the interior terminus of the White Pass Railway, thence by canoes down Fifty-Mile River on the 29th to the head of Lake Lebarge. Though the river had cleared, the great body of ice, a foot or more in thickness, on Lake Lebarge, had not yet moved. As time was urgent, however, the lake was passed by working the canoes down a narrow, discontinuous waterway along the western shore and sledging or dragging them over the unbroken ice where necessary. From lower Lebarge transportation was by river steamboat to Fort Yukon, a point of known astronomic location, whence the topographic work was taken up and carried by stadia 200 miles down the Yukon to Fort Hamlin, near the edge of the Yukon flats, also a point of known astronomic position, being a little south of the 66th parallel. The stadia check between these two points was substantially correct; but intermediate portions of the river, which had been previously mapped by crude sketches only, were found to be considerably in error.

From Fort Hamlin, the point of departure from the Yukon, the work, continued by combination of triangulation, stenometer, and stadia, was carried northward up the Dall river, thence by portage across the divide to Old Man Creek, which was descended by canoe to Bergman, on the Koyukuk, near the Arctic Circle. Bergman was reached July 14, at a distance of 300 miles from Fort Hamlin, and the work connected with that done by the Survey here in 1899* and that in northern Alaska on the Arctic coast in 1901. Here canoes and supplies had been shipped during the previous season and stored for the Kobuk river work. Accordingly, after re-outfitting, the traverse was continued northward up the Allen river, a distance of 80 miles; thence westward up one of its tributaries, known as Help-me-Jack Creek; thence by a portage of 5½ miles to the Chekayakaka, a tributary of the Kobuk river, whose waters finally flow into Kotzebue Sound. The descent of the Chekayakaka with the work was begun August 8, and the main

* Reconnaissance along the Chandlar and Koyukuk rivers, Alaska. U. S. Geological Survey, 1899.

Kobuk soon reached, down which the work was carried to Quaker Mission on Kotzebue Sound, one portage being made *en route* around a rough section of the river.

On Kotzebue Sound the work was continued southward along the eastern shore by way of Choris Peninsula and Chamisso Island to the new mining settlement of Deering, near Cape Deceit, in Good Hope Bay, where the season's work closed, and whence by ocean vessel the party reached Nome September 29.

GEOGRAPHIC.

FROM THE YUKON TO THE KOYUKUK.—The belt of country, more than 100 miles in width, traversed by the work between the Yukon and the Koyukuk, is largely occupied by a long ridge of generally low mountains and hills given off by, and extending to and southeastward from, the great Trans-Alaskan mountain range on the north, which forms the watershed between the drainages of the Arctic Ocean on the north and those of the Yukon on the south. This region, composed essentially of metamorphic rocks, is for the most part one of considerable relief, comparable to the district through which the Yukon has cut the well-known lower ramparts, the hills rising to an elevation of 3,000 or more feet, or from 500 to 1,000 feet above the timber-line. Above this line they are often barren of vegetation, being covered by rock débris. The tops in the main are rounded, having smooth, flowing contours. A district somewhat north of Old Man Creek portage, however, contains many rugged forms, giving the character of a true Rocky Mountain topography. On the northwest the surface slopes off into a gently rolling plateau country toward the Koyukuk, and is underlain for the most part by younger formations of sandstones and slates of probably Mesozoic Age, to which the name Bergman series has been applied.

DALL RIVER.—The lower 60 miles of the Dall river lie in extensive flats, which are continuous with the Yukon flats, while the upper part lies in the hilly or low mountainous country above described. Where this hilly country meets the flats, the river flows in a gorge or cañon, at whose mouth the overland pack trail from Fort Hamlin to the Koyukuk crosses the river. At ten or fifteen miles below this point the general level of the flats is interrupted by low silt and gravel mounds a couple of hundred feet in height. The length of portage from Dall river to Old Man Creek is approximately 18 miles, and coincides for the first ten miles of that distance with the Yukon-Fish-Creek trail.

OLD MAN CREEK.—Old Man Creek is approximately 200 miles in length. It trends a little north of west, and enters the Koyukuk a few miles below Bergman, near the Arctic Circle. It heads in a barren, rocky region, and has at first a torrential gradient; but soon, at an elevation of about 1,400 feet, enters a small basin some 15 miles in length, through which it meanders sluggishly in flats. At the lower end of these flats, however, it again enters a gorge nearly 20 miles in length, in the course of which it falls nearly 800 feet, the entire distance being a series of riffles and rapids, very difficult to navigate and seriously dangerous to boats. Below this gorge the stream enters another series of flats, far more extensive than the above. These in turn are succeeded by a cañon cut in the Bergman formation of sandstones and slates, and continuing nearly to the Koyukuk. But here the stream, not so torrential, is readily navigable.

ALLEN RIVER.—The Allen river enters the Koyukuk from the north a few miles above the Arctic Circle. It is one of its largest tributaries, and can be ascended for 30 or 40 miles by small steamboats. It heads in the Trans-Alaskan mountains, near the 68th parallel, whence its general trend is considerably east of south. Its length somewhat exceeds 100 miles. Along its lower course it occupies a valley from 5 to 10 miles in width, bounded on either side by irregular hills rising from a few hundred to 2,000 feet above the river. These hills are composed essentially of the Bergman sandstone series, already noted. The flats in this section of the valley have a width of 3 to 10 miles and an extent of 25 miles above the mouth. For size and number the meanders made by the river through these flats are exceptionally striking.

HELP-ME-JACK CREEK.—Help-me-Jack Creek is a western tributary of the Allen, which heads in a broad valley near the Chekayakaka, a tributary to the Kobuk. The portage, which is about six miles in length, rises to an elevation of 1,100 feet. It has long been used by the natives in passing from the Kobuk to the Koyukuk drainages.

KOBUK RIVER.—The valley of Help-me-Jack Creek, especially its upper portion, lies largely in metamorphic rocks, older than the Bergman series. The upper ten miles of the creek were found to be very shoal. While making the portage, however, early in August, the rainy season opportunely set in, yielding ample water for the descent of the rocky Chekayakaka, a distance of 10 miles to the Kobuk. Here the Kobuk was found to be a clear mountain stream,

about 100 yards in width. According to reports of the natives and of Lieut. Cantwell, however, it is not navigable far above this point, owing to its rapid ramification into numerous branches, which head in the rugged mountains to the north. Except for a few local sections near its headwaters in the first fifty miles of its course, the Kobuk can be easily descended by canoe or small boat. Three-quarters of a mile below Chekayakaka Creek occurs a rapid, through which boats can be lined with care; but a few miles farther down, the river passes over a small fall, rendering a portage necessary. Below the fall occurs a cañon, 1½ miles long, in which the stream channel is filled with large boulders, but can be run by a canoe with skill and care.

Eighteen miles below this occurs the lower cañon. It is about a mile in length, presenting difficulties at its lower end only. From this point to its mouth, a distance of 360 miles, the Kobuk is navigable for small boats without difficulty and for the lower three-fourths of this distance by steamboats.

The Kobuk valley, throughout its lower course, is 15 or 20 miles in width, but much narrower in its upper part. Just above the Chekayakaka high mountains close in upon it, and it becomes a typical mountain stream, with torrential gradient and cañon walls rising directly from its banks. Down as far as a short distance below the lower cañon the valley is from 5 to 10 miles in width. Here its floor is composed of folded and metamorphosed sediments of various types. Into this bed-rock floor are cut the cañons above described, which seldom exceed 100 feet in depth, and mark an uplift of the region, and consequent revival of the drainage, subsequent to the formation of the valley floor. Below the lower cañon the valley gradually widens, and for much of the distance is occupied by unconsolidated sands and gravels. The stream in its meanders, however, swings sometimes to the north wall and sometimes to the south wall of the valley. These walls are sometimes composed of the metamorphic rock series which makes up the great Trans-Alaskan mountain range on the north, and, running from the Mulgrave hills eastward, forms a more or less continuous range to the international boundary; and in part of unaltered sediments overlying and derived from the older metamorphic rocks. In short, the Kobuk river occupies a great strike valley, which is probably synclinal, though but little evidence was secured as to the geology of the southern wall.

GAME AND TIMBER.—Game, including moose, caribou, bear, geese and ducks, is more or less abundant between the Yukon and

the Koyukuk, about the headwaters of the Dall river and Old Man Creek; also good timber, principally spruce, abounds in this region. In the Kobuk region, however, game is scarce, consisting essentially of a few bear, with some caribou and mountain sheep in the hills to the north. This scarcity seems to be the reason why the Kobuk natives repair annually to the Koyukuk drainage to hunt. The whole of the Kobuk valley, except the lower part of the delta, is timbered; the prevailing tree is black spruce, with occasional groves of birch and cottonwood. Alder and willows of various kinds line the streams and overspread the moist mountain slopes.

NORTHERN ALASKA AND THE ARCTIC COAST.

The work in this unknown region, in charge of W. J. Peters and G. P. Phillip, topographers, and F. C. Schrader, geologist, consisted in making a reconnaissance survey through the middle of northern Alaska, approximately along the 151st meridian, from the upper Koyukuk district on the Arctic Circle to the Arctic coast at the mouth of the Colville river, from whence observations were continued along the coast northwestward to Point Barrow, thence southwestward by way of Icy Cape to the Corwin and Cape Lisburne coal fields near Cape Lisburne, in latitude approximately 68½ degrees.

Owing to the remoteness of the region, the unexplored character of the country, and the uncertainty of transportation by reason of the Arctic ice pack on the north and the extreme shortness of the season, this work was probably the most difficult and hazardous of any ever undertaken by the Survey in Alaska. Plans for reaching this unexplored part of the Territory were already considered as early as 1897, but, for the reasons above noted, reached no satisfactory conclusion without involving the wintering of a party in the region at great cost and loss of valuable time. A solution was materially aided when the discovery of gold in the widespread Klondike region in 1898 and 1899 led to the location of a couple of trading-posts in the region of the Arctic Circle on the Koyukuk river, nearly 500 miles above its mouth, and the subsequent annual visitation of these posts by boats of reliable companies with supplies.

The outfit, including canoes and supplies for the season's work, was accordingly shipped from San Francisco in 1901, and stored in cache at the Bergman post on the Arctic Circle until called for by the Survey parties in 1901.

ITINERARY.—As the success of this work required the surveyors to reach the field before the break up of winter, and Point Barrow by

September 1st, the parties set out from Skagway early in February and after proceeding over the coast range by the White Pass railway, travelled from White Horse down the Yukon, a distance of 1,200 miles, by dog sled to Bergman, which was reached April 10. This means of travel, in the language of the country, is known as *mushing*, and the traveller or individual as a *musher*. Mushing does not consist of riding on the sled, which is used for carrying the absolutely necessary supplies and luggage only, but of following on behind the sled afoot, and urging the dogs forward or running ahead on snow shoes to break a trail where none exists or it has been drifted over, as is frequently the case. To keep trail-breaking and friction in travel at a minimum, the dogs are all hitched at tandem, from five to nine in a team. Their feed, which is given once a day, usually at night, consists of some cereal, meal or flour, cooked with meat, fish, or grease. Rice and bacon, flavoured with a little dried salmon, is best. It is also contended by experienced and reliable prospectors throughout Alaska that on arduous prospecting trips, where a man is dependent for sustenance on the food supply packed on his own back, he can go farther and accomplish a greater amount of hard work on rice and bacon than on any other ration.

In mushing at the present day in Alaska two classes of dogs are in use, the *inside* or native, consisting of Siwash and Malemut, and the *outside*, consisting of various breeds of imported dogs, principally from the United States. The outside dog excels in intelligence, and is usually desirable for a leader; but the native dog is best for all-around service and for long, hard trips, as he requires less food and care, and having a dense pelt, much like that of a wolf, is less affected by the severity of the climate, hardship, and exposure. He is also less liable to become footsore on a trail of rough ice and freezing slush. In mushing, the best progress is made in relatively cool weather, at a temperature 10 or 12 degrees below zero. As the atmosphere warms, under the midday sun, the dogs, especially the native, pant and become tired or lazy, and cannot be urged. On a long trip, under reasonable conditions, 25 miles a day is a good average day's drive. In one instance, where the trail was good, 46 miles were covered by the Survey party in a single day. The mail carriers on the lower Yukon are known in some instances to have made as high as 60, the record of the Yukon country.

During the past two years, mushing in the upper Yukon has been rendered less arduous by the so-called road houses, consist-

ing usually of a log cabin and dog kennel, located at points a fair day's drive apart. Though the accommodations at these places are of the most crude order, at the rate of $1.50 per meal, they facilitate travel by affording the weary musher much-craved shelter and rest, and in lessening the amount of outfit and supplies he is compelled to lug in so primitive a method on a long journey. Where there are no road houses, as was the case beyond Fort Yukon, the traveller at the end of the day's drive selects his own camp spot for the night, and, unless provided with tent and stove, digs a hole through a depth of three or four feet of snow to the ground for a fireplace in which to cook. As a shovel is rarely carried, the snow in this act is scooped out with an axe and snowshoes. In sleeping on the snow and ice, spruce boughs form a desirable mattress where available. A light-weight tent with broad-bottom flaps and closing entrance, besides affording protection from storm and cold, is important in keeping the dogs from piling up on one's bedding and self while asleep, in which act they are wont to take unlimited licence on a cold night. Similarly, a light-weight sheet-iron stove, suited for cooking inside the tent, is very desirable, but not so indispensable, as an outdoor fire is usually required to cook the dog feed.

After doing some triangulation and topographic work in the Koyukuk valley, principally between the Arctic Circle and the 67th parallel, the party waited at Bergman for the disappearance of the snow and ice—the "*break-up*," as it is called, for the sheet of soft snow or slush, several feet in thickness, which everywhere overspreads the country during the thaw period of spring renders travel of every kind impossible. Owing to the heavy snowfall of the previous winter and the lateness of spring, the break-up period of 1901 was of unusual length, extending from the middle of May to June 6, or lasting about 25 days. During this time some astronomical observations and other investigations of a local nature were made.

The breaking up of the ice on the Koyukuk, as observed at Bergman, differed but little, if any, from that observed on most of our large rivers in the northern United States. As the stream beneath the ice became swollen and distended, the ice along the middle of the river was gradually bulged up or raised into a low arch, which by the 26th had risen four or five feet above its normal level and subsequently higher, the edges being still frozen fast to the shore. In the meantime the excess of water, increased by the surface drainage, unable to find passage beneath the ice, formed

broad streams, several feet in depth, flowing on the surface of the ice between either side of the arch and the shore. These conditions increased until the 29th, when at 2.30 P.M. the ice, now visible in the middle of the river only, broke or parted and almost bodily moved ⅛ mile down stream, when it was stopped by a jam; but at 6.30 it again started and moved about a mile. Soon after this, with increased rise of water, a general breaking up of the ice took place, and it continued to run more or less steadily until June 6, when the river cleared and became navigable for steamboat. So far as observed, the ice rarely exceeded 2½ feet in thickness, the lack of greater thickness being probably due to the protecting heavy mantle of snow. Permanent ice usually forms on the river by October 10.

It is readily conceivable that the arching feature of the ice at the time of the break-up in the Arctic regions may exceed that in less frigid climates, owing to the firmer anchorage of the edges of the ice, being frozen fast to the shore and the shallow riparian portions of the river-bed. The Koyukuk is susceptible of great rise and flooding; but, so far as known to the white men, the maximum has resulted from heavy autumn rains.

After the break-up, the party proceeded by river steamboat 80 miles up the Koyukuk to Bettles, a new supply post near the 67th parallel. From here, commencing June 13, the work was continued northward 100 miles with Peterborough canoes up a large tributary of the Koyukuk, the John river, to its headwaters, thence by a five-mile portage (2,500 feet above tide) through the mountains to the upper waters of the Anaktuvuk, the large east fork of the Colville, flowing northward to the Arctic coast. These rivers were descended by canoe and the coast reached August 15. The ice on the Colville is reported to have broken up July 16. From here, after a considerable portion of the Colville delta had been mapped, the work was continued 100 miles northwestward by canoe along the coast to Smith Bay. Here, owing to the lateness of the season, stormy weather, and rough surf incident thereto, the plane table work was dropped and transportation continued to Point Barrow, with Eskimos in native walrus skin boats, as these were found to be far more seaworthy and to sail better than the canoes. Point Barrow was reached September 3rd, where it was hoped passage to the States might be procured on some whaler; but on learning that all such vessels had long since departed, and that the ocean was expected to freeze up within a week, September 10 being the usual date, supplies and a whaleboat were procured, in which the party pro-

ceeded southwestward along the coast, hoping to catch a whaler several hundred miles farther south at Point Hope, where one was expected to touch to leave her native crew. By exceptional good fortune, however, on September 19, at the Corwin coal fields, some distance above Point Hope, the steamer *Arctic* was met with, which kindly transported and landed the party at Nome, on September 26, whence passage to Seattle could be readily procured on any of the numerous Alaskan steamers.

METHODS OF WORK.—As the Koyukuk did not break up until early in June, and the expedition, to be successful, was obliged to reach Point Barrow early in September, the season of work was limited to a period of less than three months, during which 500 miles had to be travelled. As it was impossible to make more than from three to seven miles a day up the swift waters of John river, it became necessary to make almost daily advances. To accomplish even this required the united efforts of the entire party. Consequently, many mountains could not be climbed that could have afforded opportunity for more extensive topographic sketching. The methods here used are a new combination of plane table triangulation and tacheometry, being largely the ideas of Mr. W. J. Peters, in charge of the work. At intervals of about ten miles, prominent points adjacent to the river were ascended for topographic sketching on the plane table. Two stone cairns or monuments, about six or seven feet high, were left on each of these points to mark the ends of the base which was to be used in determining the distance to the next station. The next station was usually selected before the base was marked, so that the base might be laid off at right angles to the next station, or as near to the right as the shape of the summit would permit. The direction of the base was always projected on the plane table sheet, so that the angle between it and the line to another point could be measured. The length of the base was from 300 to 600 feet, and was chosen with regard to the estimated distance and direction of the next station so as to subtend an angle of about 22 minutes, which was measured with the micrometer screw of the alidade.

Between stations a traverse of the river was made with prismatic compass and stenometer. The plat of the traverse was transferred to the plane table sheet and fitted to the located points. The orientation of the plane table was controlled by the azimuths, determined with the theodolite when necessary.

This method of plane table locations was followed from Bergman to twenty miles beyond the summit, and, judging from inter-

sections on points on either sides of the route, it was satisfactory and sufficiently accurate for the publication scale of the exploration map now in course of preparation. The compass and stenometer were used from twenty miles beyond the summit to the end of the traverse on the Arctic coast. The rapidity of travel, and the absence of high or prominent points along this part of the route, prohibited further use of the above plane table methods. Latitudes and magnetic declinations were obtained when the weather permitted.

GEOGRAPHIC.

THE KOYUKUK RIVER.—The Koyukuk drains the northwestern part of the Yukon basin. It is one of the largest tributaries of the Yukon, which it enters on the north, about 450 miles above its mouth. It has a very large drainage basin, which, as already noted, heads to the west of the Chandlar basin, in the Trans-Alaskan mountains, in the northeastern part of Alaska, near the 69th parallel and the 150th meridian. From that point its axis trends southwestward through a distance of more than 300 miles direct toward the head of Norton Sound to the Yukon, giving to the river a length of approximately 700 miles. It is navigable by steamboat to Bergman, a distance of 450 miles above its mouth, and at high water to Bettles, 80 miles farther. Besides the South Fork, the principal tributaries, five or six in number, each approximately 100 miles in length, head in the Trans-Alaskan mountains to the northwest, and are received above the Arctic Circle. In its upper part, near the edge of the mountains, in the region of the Arctic Circle, the Koyukuk basin has a width of nearly 150 miles. Here the valley becomes broad and open, and is largely occupied by a gently rolling plateau country, which has a general elevation of 2,000 feet, being about 1,000 feet above the river. Northward this plateau character gives way to hilly inter-stream areas and ridges, which merge into the foothills of the mountains on the north.

MOUNTAINS.—In the vicinity of the 68th parallel the work traverses a rugged range of mountains which was found to have a width of approximately 60 miles and an elevation of 6,000 feet. This range is supposed to be the northwestward continuation of the Rocky Mountains of the United States and British Columbia, which here trend nearly east and west across Alaska, forming the great Trans-Alaskan watershed between the Yukon on the south and the drainages of the Arctic Ocean on the north. It was not expected to find these mountains extending in such force so far to the westward. At present there seems to be but little doubt that, as a

pronounced orographic feature, they continue, though with decrease in elevation and width, through to the west coast in the vicinity of Cape Lisburne. In the region of the 152d meridian the north edge of the mountains lies about 150 miles from the coast. East of this, however, it curves strongly toward the north-northeastward, so that in the region of the 147th meridian the mountains lie quite near the coast.

On the south the rise from the rolling Koyukuk country to the mountains is by foothills, but rapid. On the north the mountains break off abruptly, much as they do along the edge of the Great Plains in the western United States. Faulting and uplift are evidenced by marked deformation of the strata and the presence of prominent fault scarps, sometimes of considerable extent.

A view across the top of the range has the appearance of a dissected plateau, whose former surface is denoted by the sea of peaks which, in general, rise to 6,000 feet, while the valley floors lie approximately at 2,000. The range seems to be somewhat higher near its northern and southern sides than in its middle portions.

The drainage of the range is principally southward into the Koyukuk. John river, the stream ascended, rises near its northern edge and flows almost entirely through it. The master drainage ways in this part of the Territory are therefore of a transverse character, extending across the strike and trend of the rocks as well as transversely to the trend of the range, while the tributaries to these larger streams nearly always flow along the strike and enter the master streams at right angles.

The rocks composing the range consist of several metamorphic series of limestones, slates, and schists, apparently much older than those forming the rolling plateau country on either side of the range. Toward the north side there are also sandstones, conglomerates, grits, and limestones, some of which are Paleozoic.

Plateau and Coastal Plain.—Along its northern base the range, at an elevation of 2,000 feet, is met by a gently rolling plateau country composed of Mesozoic rocks, which, with gentle slope, extends northward a distance of 100 miles, from which point the profile, continuing 75 miles farther northward to the Arctic coast, traverses a nearly flat tundra country or coastal plain, underlain by late Tertiary beds several hundred feet in thickness. In the plateau country the valleys are shallow and open, with no well-defined banks, while in the inland portion of the coastal plain, though the valleys continue open, the river banks are well defined. Along the coast portions of the edge of the coastal plain are fringed by tidal lagoons

and embayments and dotted by lakelets. It is not rare here, in low bluffs and sea-cliffs, to find ice taking the place of geologic strata, rising to a height of twenty feet above sea-level and extending inland for unknown distances. Much of the topography of the plateau country in aspect has been softened by the presence of glacial deposits, showing the ice-sheet to have extended 100 or more miles northward from the mountains.

TIMBER.—A moderate growth of spruce and cottonwood extends up John river into the mountains to near the middle of the range. Here the timber-line occurs approximately at 1,600 feet. From this point to the coast the only representative of timber is the willow. It is usually much dwarfed or stunted in growth, rarely large enough to furnish a tent-pole. Toward the coast, if present at all, it becomes a mere shrub, less than knee high,or is limited to the trailing variety, with only the points of the leaves appearing above the moss. At various points along the coast drift timber, washed ashore in embayments, is used by the natives for fuel. So far as observed, the coast is totally barren of timber from the mouth of the Colville down to beyond Cape Lisburne.

FISH AND GAME.—No fish to speak of were noted on John river, though trout occurred in some of its tributary streams. They also occur in the Anaktuvuk river and some of its tributaries. On the lower Colville, and at various points along the coast, the principal fish of the natives seems to be a whitefish. It is usually caught by net, and, so far as observed, is probably not abundant. In the mountains along John river, mountain sheep and caribou are present, and form a principal food supply of the natives. At certain periods of the year caribou are hunted as far north as the coast. A few bear are present in the mountains, and polar bear are frequently taken by the natives along the coast. Among birds the ptarmigan is probably the principal for all seasons of the year, but during the latter part of the summer ducks are taken by the coast natives in very large quantities.

THE TIDES IN THE MIDST OF THE PACIFIC OCEAN.

A STUDY BY

ALEXANDER BROWNLIE.

With regard to the general subject of tides, people seem to be impressed with the idea that they ebb and flow with the utmost regularity; that they come and go with mathematical precision; that highest floods occur precisely on the days when the moon is new and full, and *vice versa;* that lowest ebbs occur precisely on the days when the moon is in the 1st and 3d quarters; that when the moon is in the meridian of a place bordering on the sea, then highest floods occur precisely at noon and midnight. They seem to suppose that the movements of the tide are as regular as the movements of the moon itself!

But observation shows that it is not so. On the contrary, everywhere tidal movements form a mesh of irregularities. They are irregular in time-intervals from one high water to the next; from one low water to the next; from high to low, and *vice versa.* There is great irregularity in the daily amount of supply, and great irregularity in the daily distribution of supply, and great irregularity in the speed of supply.

In the present article we make a special study of tide as it has been observed to act right in the midst of the Pacific Ocean, because it is elsewhere assumed that in it lies the source from whence the tides of the whole world come. "In that ocean [the promoters say] the tides have uninterrupted sway." If that is so—if it is true that they have almost uninterrupted sway in that ocean—then we ought to find them working there in harmony with the rules of the science. Of all oceans on the face of the earth, that one ought to furnish the proof to vindicate the truthfulness of the science; or, *per contra*, to show its utter fallacy. In beginning our study we will, in the first place, consider the question of time-intervals.

I. What are the Facts as to Time-Intervals in the Midst of the Pacific?

At Honolulu, Hawaiian Islands, the intervals of time from one high water to the next vary from 10¼ to 14¾ hours. A range so wide apart shows great irregularity compared with the absolute regularity of the movements of the moon; but, to take a lower

standard of measure, we will take the standard of measure observed in the time-intervals in the Atlantic. For example:

The variation in the range from one high water to the next at

	HRS.	MIN.		HRS.	MIN.
* Charleston, South Carolina, is...	11	52	to	13	00
Sandy Hook, New Jersey......	11	56	to	12	52
St. Johns, Newfoundland......	12	00	to	13	08
Lisbon, Portugal.......	12	10	to	12	55
Rochelle, France..............	12	12	to	12	47
Queenstown, Ireland...........	12	03	to	12	37

The variation shown in the table ranges from 34 minutes to 1 hour 8 minutes; but at Honolulu it is 4½ hours! Now, a variation 300 per cent. greater at Honolulu clearly shows that the driving power there acts with more irregularity than does the driving power in the Atlantic; that the two actions are totally distinct in the matter of time-intervals; and this separate type of tide observed in the *midst* of the North Pacific is also observed upon the *shores*. For example:

The variation in the range from one high water to the next at

	HRS.	MIN.		HRS.	MIN.
San Diego (La Playa) California, is	10	57	to	14	10
San Francisco Entrance (Fort Point)	9	56	to	14	59
Astoria (Columbia River), Oregon.	11	07	to	14	00
Sitka, Alaska..................	10	55	to	14	25
Yokohama (Nishihatoba), Japan..	10	07	to	15	18
Nagasaki, " ..	11	18	to	14	09
Hongkong, China...............	10	28	to	13	34
and in the midst					
Honolulu (Oahu Island), Hawaii..	10	11	to	14	53

But proceeding with our study, we will now pass from the North Pacific to the South Pacific to observe at Apia (Upola Island), Samoan Islands, and there we find exceedingly regular time-intervals; the variation in the range being only 32 minutes—that is, from 12.07 to 12.39. Now, a variation of 32 minutes at Apia makes a very striking contrast when compared with the 4½ hours at Honolulu. The two types are absolutely different from one another; and the contrast is the more striking when we consider the proximity of the two places in the *one* vast expanse; the vastness of

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* Authorities: *The Tides*, by Geo. H. Darwin; and *Tide Tables*, by the United States Coast and Geodetic Survey. The figures in our tables in this article are nearly all taken from the U. S. Tables for January 1900.

which is so great that the islands in comparison seem but mere specks of dust holding up their heads in the midst. Yet, in the one there is a great regularity of action, whilst in the other there is a remarkable irregularity of action. In view of these differences, so very remarkable, it is pertinent to ask the questions:

Can the moon cause the irregularity at Honolulu and the regularity at Apia?

If the moon is the power that lifts tide in the Pacific, why are the time-intervals so short at the one and so long at the other?

At the same time we do say that the fact of a difference so enormous clearly throws doubt upon the moon as a lifter of tide; and as clearly points to the inference that we must look elsewhere than to it for the cause of the remarkable differences, because the time-intervals of the moon are regular to the thousandth of a second.

In strange contrast to our finding of remarkable differences in time-intervals stand the unsupported statements in *The Tides* that "Tides are most normal in the Pacific Ocean" (page 161); and that "The tidal forces in it have almost uninterrupted sway"! (page 186).

Our finding shows clearly that the pattern of tides in the North Pacific cannot be taken as the pattern of the tides in the South Pacific; they are not one in pattern, but two, and the two are absolutely distinct from one another in type! Therefore the author of *The Tides* is in error when he speaks of them as normal throughout the Pacific Ocean.

2. The Amount of Tidal Supply in the Midst of the Pacific.

In our second heading we shall consider the question of the daily amount of supply in the midst of the Pacific.

At Apia the average rise is 3 feet per tide.
" Honolulu " " $1\frac{3}{10}$ " "

The variation in the amount of supply shows a difference of 100 per cent. in favor of Apia; that difference is enormous when we consider the fact that it takes place, not upon a continental shore, where ordinarily the rise varies exceedingly in height from place to place, but upon mere specks in the midst of the Pacific itself.

If our study were political, and the question under consideration one of national tariff, for instance, then it would be pertinent to ask, Why is Honolulu laid under a kind of prohibitory tariff and Apia granted free trade in the article of salt water? It would also be

intensely interesting to know by what means Apia has the "pull" over Honolulu; the fact that it receives a double supply would seem to indicate that the moon has the power of discriminating between the two places! The facts of the case being so, again the inference is quite clear that we must look elsewhere than to the moon for the cause of the differences.

We will next consider the question of the distribution of supply —say the daily distribution during the course of one month. The rules of the science are very clear and precise in regard to this question. For instance, according to them, when the moon is new, or full, it works in perfect unison with the sun; at that time their united forces of attraction lift the water of the ocean three times higher than upon the days when the moon is in 1st and 3d quarters; that when it is in 1st and 3d quarters the power of the lifting forces is reduced by two-thirds, because sun and moon are then struggling against one another; therefore, in the struggle, they are mutually destructive of each other's lifting force.

If the tides in the Pacific are in harmony with these rules, then the greatest distribution of supply must be delivered upon the days when the moon is new or full, and, *per contra*, the smallest distribution of supply upon the days when the moon is in 1st and 3d quarters. That being clear, we will apply the rules to the facts in the case. But, first, an explanation is in order, seeing that we draw our figures from tide tables—and a tide table does not tell us what has been but what is to be. A forecaster can only forecast when he has been supplied *in advance* with *local* tidal data; therefore such forecasts are merely proximate; but the fact remains that they are based upon *actual* observation, otherwise they would be practically worthless to navigators anywhere, because

if we want to know the rise of tides in a given harbour we must watch the movements at that harbour (*The Tides*, page 194).

Of course, the rule just quoted is only a *recent* amendment, as it were, which has been made to the *original* rules of the science. In short, one cannot make a practical tide table by mathematics only; but it can be done very correctly for any harbour after one has observed its tides for awhile, because tides are *local* in their action, and because the

knowledge of the (supposed) flow of a (globe) tide-wave can never suffice for accurate prediction of tide anywhere (*The Tides*, page 193).

Precisely so. A very important truth to remember. With that explanation of the most *practical* thing in the science to-day we will now give a table for one month at Apia:

APIA, 171° 44 W. L., JANUARY, 1900.

MOON'S PHASES.	DAY OF MONTH.	HEIGHT OF RISE IN FEET AND TENTHS.	
		1ST FLOOD TIDE.	2ND FLOOD TIDE.
New...............	1	3.0	3.3
	2	3.1	3.4
Perigee............	3	3.0	3.0
(near the earth.)	4	3.0	3.0
Equator............	5	3.0	3.0
	6	3.1	3.0
1st Quarter.........	7	3.1	
	8	3.0	3.1
	9	2.9	3.2
	10	2.9	3.2
	11	3.0	3.0
Farthest north......	12	3.0	3.4
	13	3.1	3.4
	14	3.1	3.4
Full...............	15	3.1	3.3
	16	3.0	3.2
	17	3.0	3.1
	18	2.9	2.9
Apogee—Equator...	19	2.8	2.8
(far from the earth.)	20	2.7	2.6
	21	2.6	2.5
	22	2.5	2.4
3d Quarter.........	23	2.5	
	24	2.3	2.6
	25	2.3	2.7
Farthest South.....	26	2.4	2.8
	27	2.6	3.0
	28	2.8	3.2
	29	3.0	3.4
New...............	30	3.2	3.5
Perigee	31	3.3	3.5

According to the table for Apia, the forecast for the second day is higher than that for the first day; yet on the first day the moon was new the transit occurred towards midnight. Then the supply predicted from time of new moon to first quarter is almost stationary in amount, yet the moon was at perigee on the third day; and the rise at first quarter is about the same as that at new moon and perigee combined! Now, that is not in harmony with the rules; on the contrary, it is just the opposite, because at the

time of first quarter sun and moon are pulling against one another with all their might; therefore, instead of a rise of 3 feet $\frac{1}{10}$th on the seventh day the rise ought to be one foot only! Then, again, the amount predicted for the twelfth day (6 feet 4 for both tides) is precisely the same as that awarded to the fifteenth day—the day when the moon was full. The fact that tide should rise as high and higher than at full moon, for three days ahead of full moon, is positively contrary to the rules. Then, again, from the eighteenth day the supply diminishes, but on the twenty-third day—the day of the third quarter—the rise is 2½ feet. That is all wrong, for the rise ought to have been 1 foot instead of 2½ feet! Lastly, the rise awarded to the thirty-first day exceeds the rise awarded to the thirtieth day; yet on that day the second new moon took place. Furthermore, the moon was at apogee on the nineteenth day; yet, notwithstanding that fact, the predicted rise grows less and less until the twenty-fourth day. For example:

At apogee the rise for both tides amounts to 5 feet 6; whereas on the twenty-fourth the rise for both tides amounts to 4 feet 9, showing a loss of $\frac{7}{10}$ths of one foot five days *after* apogee! From all this it is clear that the practical forecaster did not make his predictions in accordance with the rules, and it is quite clear that there is a small difference between the facts in the case and the fancies of the science. But the question naturally arises, Why did the forecaster cast away all his original rules? Were it a question in theology the correct answer would be, Because his heart is desperately wicked! But seeing that it is only a question in science, our answer is, Because he cannot make a practical table by the original rules! In order to make a practical forecast he must cast away every one of the original rules and abide wholly by the *recent* amendment to them, because it is of more value than all of the original rules combined!

If we want to know *local* tides we must study them *locally*. The study of a so-called globe-travelling wave is absolutely unnecessary; for a knowledge of the science only cannot make one an expert in forecasting practically. That, in substance, is the amendment; but that wholly practical amendment, which is of more value than all the promoter's rules combined, was not discovered by a promoter of the science. On the contrary, it was discovered by a harbourmaster of Liverpool—harbourmaster Hutchinson, the first practical master of the tides. Although he knew nothing of the science, yet he taught the promoters how to make a practical forecast, and he came to be a master because he studied the tides of

his own port for twenty years consecutively! That well-authenticated historical truth in the history of the science proves that this invaluable new light upon the subject was discovered during the time when all the so-called great masters of the fanciful science slumbered and slept. Yet they do not give him true credit for his remarkable discovery to-day; nor did they awake to the value of his discovery until after generations of practical harbourmasters had been in full possession of a lucrative business in the publication of tidal almanacs. The theory was created in the seventeenth century, but the theorists did not learn to become practical until nearly one-third of the nineteenth century had run its course! It was only at the later date when they actually began to study the tides of nature. And yet they were all professors of mathematics!

Having observed the facts regarding the distribution of supply in the midst of the Pacific at Apia, we will next enter into the consideration of the facts regarding the distribution of supply at Honolulu, and present these facts in a table for that port:

HONOLULU, 157° 30′ W. L., JANUARY, 1900.

MOON'S PHASES.	DAY OF MONTH.	HEIGHT OF RISE IN FEET AND TENTHS.		
		FIRST RISE.	SECOND RISE.	SECOND LOW WATER.
New	1	2.2	0.7	−0.2
	2	2.2	0.7	
Perigee.........	3	2.1	0.8	
	4	1.9	0.9	
Equator	5	1.7	1.0	
	6	1.4	1.1	
1st Quarter	7	1.2	1.2	
	8	1.0	1.5	
	9	0.8		
	10	1.7	0.7	
	11	1.9	0.7	
Farthest North...	12	2.0	0.7	
	13	2.1	0.7	
	14	2.1	0.7	
Full.............	15	2.1	0.7	
	16	2.0	0.7	
	17	1.9	0.8	
	18	1.8	c.8	
Apogee—Equator	19	1.6	0.9	
	20	1.5	0.9	
	21	1.3	1.0	
	22	1.1	1.2	

HONOLULU, ETC.—*Continued.*

MOON'S PHASES.	DAY OF MONTH.	HEIGHT OF RISE IN FEET AND TENTHS.		
		FIRST RISE.	SECOND RISE.	SECOND LOW WATER.
3d Quarter.......	23	1.0	1.4	
	24	0.8	1.6	
	25	0.7		
Farthest South...	26	1.8	0.7	
	27	2.0	0.7	
	28	2.1	0.7	
	29	2.1	0.8	
New	30	2.1	0.9	
Perigee..........	31	2.0	1.0	

According to the table for Honolulu (the moon's transit occurred about 11 P.M. on the first day), it is clear that the first day has practically one high water only, yet on that day the moon was new about 11 P.M., and at 9¼ P.M. one of the very lowest of all low tides occurred! It is also clear that the fifteenth day has practically one high water only, yet on that day the moon was full. Upon both of these days the second high water ought to have risen about as high as the first, because at that time both sun and moon were pulling in unison with all their might, but, nevertheless, their united pulling fails completely to lift the second tide anything near as high as the first. Now, the actual lifting in that second tide is a flat contradiction of the science! It is a flat denial of the so-called doctrine of equilibrium, because the natural distribution shows that there is no equality at all between the first and second tides! That remarkable fact is not only disclosed at the time of new and full moon, but almost all through the month. The distribution of supply at Honolulu is so regulated by nature itself that it persistently refuses to be governed by the rules of the science! And yet the author of *The Tides* tells us that tides are normal in the Pacific!

We also observe by the table that the combined lift of the first and second tides, at the time moon was new and full, is only 2 feet 9 and 2 feet 8, respectively; whereas the combined lift at the time of 1st and 3d quarters amounts to 2 feet 4. That is all wrong, for instead of rising 2.4 it ought to have risen only $\frac{9}{10}$ of one foot. In fact, the distribution of supply at Honolulu, when viewed from the standpoint of the rules, is a complete failure, and discloses a tidal

anarchy; for it is quite clear that the tides there are not governed by lunar attraction at all, and the fact of the mathematician's lunar anarchy reigning in the very midst of the Pacific itself clearly absolves us from our allegiance to both Newton and Laplace; and for our ally in this act of open rebellion we claim the weighty support of the greatest living promoter of the science on earth, who said, only recently:

> Both the theories (of Newton and Laplace) must be abandoned as satisfactory explanations of the true conditions.—*The Tides*, page 180.

But we have one more reason still for our act of rebellion; a *cubic foot* of lightest water weighs 62¼ pounds. Now, we are told that during the flow of one very high flood 700,000,000 *cubic yards* of water pass Liverpool. If the moon can lift so enormous a load of water 30 feet or thereby, why can't it pick up a straw? Why can't the moon pick up the feather of a moth's wing at Liverpool? The supposed potency of the moon to lift up enormous loads of water contrasts strangely with the fact of its impotency to raise a straw and so manifest its strength openly!

(*To be continued.*)

PHYSIOGRAPHIC NOTES.

BY

RALPH S. TARR.

GEOLOGY AND WATER RESOURCES OF NEZ PERCE COUNTY, IDAHO.—Among the important publications of the United States Geological Survey are the Water Supply and Irrigation Papers, which contain much geographic material of value. They consider the question of the surface water and the underground water supply with especial reference to their usefulness in irrigation; but in connection with the work, great part of which is done by trained physiographers, a great deal of physical geography is presented, much of which is distinctly new. The papers are, as a rule, well illustrated, which adds much to their geographic value. Of these papers numbers 53 and 54, by Prof. I. C. Russell, may be taken as a type; and, in order to call attention to these papers in general, and this one in particular, I propose to abstract his discussion of the water resources of the Nez Perce region somewhat fully.

Nez Perce County is situated in western Idaho, being bordered on the west by both Oregon and Washington. The ground covered in Russell's report extends westward, somewhat beyond the limits of the county. The reason for undertaking the investigation is the fact that this section has an exceedingly fertile, dark, rich soil, resulting from the disintegration of volcanic rocks, and is the seat of a very extensive and rapidly-growing industry of wheat-raising. The climate is admirable, excepting that there is not quite rainfall enough for all seasons; therefore, any addition to the water supply that could be discovered would prove of great value. While the rivers have much water, this is practically inaccessible, because of the fact that the streams are deeply set in cañons, and at present the construction of storage reservoirs is rendered difficult by conflicting interests. For these reasons attention has been directed to possible subterranean sources of water supply, and a number of wells have been drilled, one of which yields a good surface flow. Any light, therefore, that can be thrown upon the underground water supply will prove of great value to the region.

The Nez Perce district is divisible into two very different sections—one in which the structure is a complex of sedimentary,

igneous and metamorphic rocks, and the other, and younger, a vast extent of basalt, with included layers of clay, sand, gravel, and volcanic dust. The first and older was greatly disturbed by mountain-building and worn by denudation before the lava was poured out. There is evidence of immense denudation in these older beds, and the land which they form is drained by a well-developed, mature system of water ways. During the glacial period the valleys of these mountains were occupied by local valley glaciers, which, however, do not seem to have united to form a single ice-sheet.

That the pre-Tertiary land was greatly denuded is proved by the peaks, such as Cottonwood Butte, which rise like islands in the sea above the vast floods of lava which fill the Snake and Columbia valleys. These peaks in some cases reach an elevation of over a thousand feet above the surrounding basaltic plateau. The great extent of the denudation by which this old land was carved is further indicated by the fact that the formation of the deep cañons which cut the lava, representing the work of erosion since Tertiary time, is small compared with the task which was previously accomplished in forming the mountain peaks by removing surrounding material. Against these mountains, sheet after sheet of molten rock was poured out, rising higher and higher on the sides, and doubtless completely covering many neighbouring peaks of lesser height. One of these peaks projecting above the lava plain is known as Steptoe Butte; and since it is a typical example of these eminences, Russell proposes the name *Steptoe* as a geographic name for an island-like area in a lava flow.

That the lava floods rest upon a land similar in geological structure to the Steptoes and the neighbouring mountains is proved by the fact that the deep cañons which have been cut in the lava reveal gneiss, schist, quartzite, etc., unconformably beneath the basalt. The geological age of these rocks is not certain, though the few fossils found in them indicate that some of them, at least, were formed in the Carboniferous time.

The basalt, which is known as the Columbia River lava, is a part of one of the most widely-distributed geological formations on the continent. Its exact boundaries have not been traced, but it lies almost entirely within the drainage area of the Columbia valley, forming the surface over nearly the whole of Washington and Oregon, east of the crest of the Cascades, and extending into Idaho until it meets the older formations of the western base of the Rockies. The area of the formation is estimated to be 200,000,

possibly 250,000 square miles, and its greatest known thickness more than 4,000 feet.

The accumulation of this immense mass of lava required a long period of time, with intermediate periods in which layers of sedimentary material, principally clays and sands, were accumulated to be covered by later flows.

In places, also, the lava sheets are separated by layers of volcanic dust containing the silicified trunks of trees, which grew on a soil formed by the decay of the underlying layer, thus showing that the intervals between the flows were in some cases a century or more in duration. The lava came through fissures in the earth's crust—in what are known as fissure eruptions—and spread widely over the land, from which it is evident that each sheet was spread out horizontally.

The lava sheets are still essentially horizontal over broad areas, though frequently with gentle dips, and in some areas tilted, and even sharp-folded and faulted. On the eastern slope of the Cascades the dip is towards the east, showing that a large part of that range has been elevated to a height of at least 6,000 feet since the lava was poured out.

The fact that the Columbia river lava came to the surface through fissures as molten rock, and that it spread widely over the land, is shown not only by the generally level condition of much of its surface as it exists to-day, and by the absence of volcanic mountains, cinder cones, etc., in connection with it, but is demonstrated in a most instructive manner where denudation has exposed the dikes formed by the cooling of the liquid magma in the fissures through which it was forced to the surface. Over an area of at least 400 square miles on the eastern slope of the Cascade Mountains in Washington, to the south of Mount Stuart, the lava has been eroded away so as to lay bare the rocks on which it formerly rested. In the surface there exposed many hundreds, probably thousands, of dikes are to be seen. These dikes, composed of dense basaltic rock, range in thickness from a few feet to 160 or more feet, but in general they are from 15 to 60 feet across.

These vast fissure eruptions caused the lava to spread over the land surface like an inundation, covering broad plains and extending far into pre-existing valleys. They differ from the eruptions of volcanoes in this respect and in the absence of cones. Such vast floods naturally seriously interfered with drainage; and that many lakes were formed is proved by the presence of lake deposits between the lava sheets, in some cases of great thickness and wide extent. It is from the plant fossils preserved in these sedimentary beds, and in the beds of volcanic ash, that the age of the lava is proved to be Tertiary. It is probable that the lava did not cease until late in the Tertiary, or even possibly in the beginning of the Pleistocene time. The western margin of this sea of molten rock was west of the present crest of the Cascade Mountains, giving a width of fully 250 miles; that is, a width equal to the distance from

New York City to Rochester. The different layers of lava, of which twelve to fifteen sheets are sometimes exposed in a single section on a cañon wall 2,000 feet high, vary in thickness, being in general from 50 to 150 feet thick in each case. The surface of the plain is covered with a deep residual soil, so completely decayed that one may travel for miles without seeing a rock fragment.

This pile of lava sheets, with their intercalated layers of volcanic ash, lava beds, and alluvial fan deposits, reaching a depth of over 4,000 feet, now has a surface-level of from 3,000 to 3,300 feet. From this it is evident either that the bottom of the valley was at least 1,000 feet below sea-level—as at present is the case in the Dead Sea and Death Valley*—or else that there has been a general subsidence of the region to an amount of at least 1,000 feet; and the facts in the field point toward the latter conclusion. This broad subsidence has not greatly disturbed the original horizontality of the strata.

Russell makes use of the facts in this region for a discussion of their bearing upon the theory of isostacy. The total volume of the Columbia river lava is not far from fifty to sixty thousand cubic miles. Its weight is about 160 pounds to the cubic foot, so that where the lava is 4,000 feet thick its pressure is not far from 320 tons to the square foot. Would the addition of such a mass of rock to the surface cause a regional depression in the earth's crust? Russell considers that the answer would be in the affirmative, and that the subsidence in the region has not been less than 3,500 feet, and probably as much as 4,500 feet. He believes that the downward movement began early in the extrusion of the lava. He calls attention also to the fact that the Cascade Mountains to the west, which also consist in part of Columbia river lava, have been upraised with a dip toward the depressed region. Their present elevation is from 7,000 to 7,500 feet. There has been an uplift also in the east. Thus it seems evident that portions of both the eastern and western margins have been raised to an amount equal to 3,000 to 3,500 feet, while the central part has been depressed to about the same amount from what would have been the surface-level of the lava-covered country, in case there had been no subsidence. "These movements have been in large part of the nature of a tilting of broad blocks of the lava bounded by monoclinal folds and faults."

The drainage of this lava-flooded land is interesting. It is

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* The Dead Sea is 1300 feet below the sea-level; Death Valley between 200 and 300 feet.

essentially a region of steep-sided cañons, with broad, generally level, remnants of the dissected plateaux between them. After much interference by lava-flows, and many episodes not now understood, a drainage was begun upon the plateau. This was interfered with by changes in level, and some of the streams appear to have maintained their courses across the uplifted parts, being in the nature of *antecedent streams*. This was true, for example, of the Snake river where it crosses the Craig Mountain uplift. But in some cases the uplift was so rapid that the streams were unable to corrade or upgrade their channels as fast as the barrier rose, and these streams were turned from their courses. An illustration of this is furnished by the Grande Ronde river, which was turned aside by the Blue Hills dome; and another by the Clearwater escarpment, which turned the Snake river aside at Lewiston. Other streams are *consequent* upon the monoclinal slopes; and still others have developed their *consequent* courses by headwater erosion. Of these streams the Snake river is the largest in the Nez Perce region. It is characteristically a cañon stream for nearly its entire length of about 750 miles. It is interrupted by falls and bordered by cañon walls reaching from a few hundred to 4,000, and even in one case to 6,000 feet.

The cañons are not narrow trenches with vertical walls, but, owing to the variability in the enclosing, nearly horizontal strata, they are widened, especially at the top, and their walls are greatly sculptured by lateral streams. Therefore the topography is often very diverse. In some cases the diversity is due to the underlying, more resistant formations of metamorphic rock; and in this case the cañon form is characteristically that of a part of the Grand Cañon of the Colorado, namely, a narrow cañon at the bottom where the rocks are most resistant, and a broader, outer, and upper cañon where the lava sheets form the wall. The prime reason for the broadening of the valley in the lava-walled portion is the variation in texture from the hard lava to the intercalated beds of lava, volcanic ash, etc.* These softer beds, upon being slowly removed, undermine the lava and cause a succession of landslides, which broaden the valley and render the slope less steep and the surface more irregular. There is an instructive discussion of landslide topography in the article.

An episode in the history of the drainage which has been brought forth by Russell's studies is the change which has evidently taken place from a cañon-making stream to one of gravel deposit. The cañons were excavated to a depth of from 2,000 to 4,000 feet; then

gravel to a depth of at least 230 feet and probably 360 feet was laid down. These have subsequently been re-excavated, and these streams have again begun their tasks of cañon-making. The explanation of this change from corrasion to aggrading in the case of swift rivers with high grade seems to be the supply of gravels furnished during the glacial period. At that time precipitation was probably increased beyond what it was before or what it has been since; and this, added to the supply of water from the melting of the glaciers, gave to the rivers such a load of detritus that they became overburdened and began aggrading their courses. With the disappearance of glacial conditions the rivers returned to their normal work of corrasion, and have not only cut out much of the gravel, but have set to work on the under rock. The gravel remains in places in terraces on the river side.

Russell does not consider the problems connected with the possible use of the surface water, but he calls attention to the existence of certain springs which are supplied with water percolating through the porous beds. Places where such springs are most likely to occur are pointed out and the problem of their occurrence and use is discussed. The general question of artesian water supply is also considered and the principles applied to this particular region where water is liable to be found in some of the porous layers of sediments and volcanic ash between the beds of lava. In fact, some artesian wells have already been bored in these beds. There is also a short section devoted to economic geology, in which attention is called to the existence of building stones, lignite, and the metals gold, silver, and copper.

THE PRE-GLACIAL COURSE OF THE MIDDLE PORTION OF THE GENESEE RIVER. *

BY

R. H. WHITBECK.

INTRODUCTION.—Rising in northern Pennsylvania, the Genesee river flows northward across New York and empties into Lake Ontario at Charlotte, not far from the City of Rochester. The river, with its tributaries, drains an area of about 2,500 square miles.† The course of the river is divided into four distinctly-marked portions:

(*a*) From its headwaters to the village of Portageville it flows in its pre-glacial valley. For some twenty miles south from Portageville the valley bottom has an average width of about one mile (Fig. 5), being a little broader than this in some parts. This portion of the valley is deeply filled with silt, the actual depth of which is not known.

(*b*) From Portageville to Mount Morris the river now flows in a rock gorge (Figs. 3, 4, 7, 8, 9), in part, at least, post-glacial. For several miles below Portageville the gorge is narrow, and the rock sides are precipitous (Fig. 4), the water flowing on a rock bottom. In this portion are the celebrated Genesee Falls, called respectively the Upper, Middle, and Lower Falls. A short distance below the last fall the character of the gorge changes. The channel becomes broader and the side walls more sloping, all the features indicating that this portion of the gorge is older than that immediately above. This continues but a short distance, when, by a sharp curve to the left, the river again follows a narrow gorge, plainly post-glacial; but, after describing a U-shaped curve, the river again flows in a broader and older channel, ranging in width from ⅓ to ¾ of a mile. In this latter portion the valley-bottom is filled with till, and the river does not flow on rock. There are many facts which cannot be introduced into this paper which strongly suggest the existence here of an "inter-glacial gorge." The broader gorge continues nearly to Mount Morris, when, by making another circuit, the river again flows in a narrow post-glacial rock-cutting (Fig. 8),

* The original work upon which this paper is based was done for a thesis at Cornell University.

† Report of John Bogart, State Engineer and Surveyor of New York, 1890.

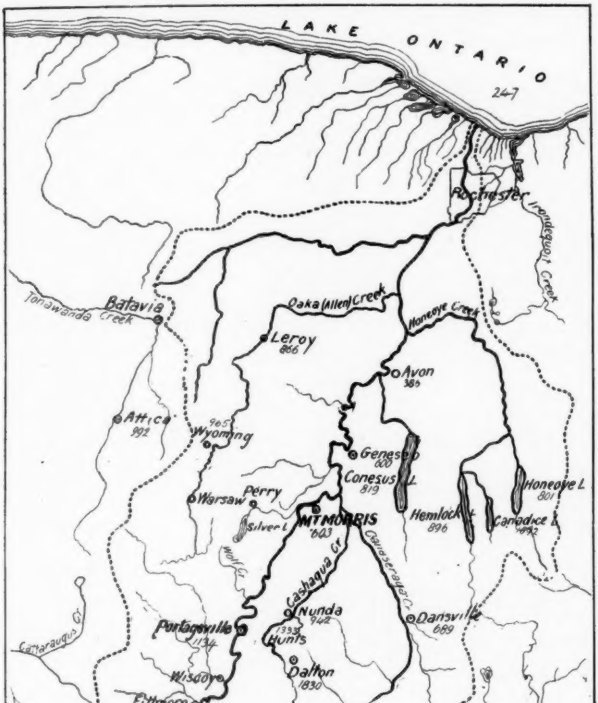


FIG. I.—MAP OF GENESEE DRAINAGE BASIN.

Correction.—AT AVON THE ELEVATION IS 586 FEET; AT DALTON 1,330 FEET.

and afterwards emerges into a broad, ancient depression, the Lower Genesee valley (Fig. 9).

(*c*) From Mount Morris to Rochester the river flows in a pre-glacial valley, broad, flat-bottomed, and filled with silt to a depth of about 200 feet, as is shown by borings at Mount Morris, Cuylerville, and elsewhere. As the river approaches Rochester, the valley becomes less and less distinct, and blends into a plain.

(*d*) From Rochester to Lake Ontario the Genesee flows in a narrow, post-glacial gorge, near the head of which are three falls of 98, 20, and 105 feet in height respectively.

TOPOGRAPHY OF THE PORTAGEVILLE–MOUNT MORRIS PORTION OF THE GENESEE BASIN.—The region with which this paper is chiefly concerned is the portion of the Genesee drainage basin lying between the latitude of Portageville on the south and Mount Morris on the north (Fig. 2). At the former village a vast accumulation of moraine (Fig. 2) has so filled the ancient valley that the river has been turned aside into a new course. At the latter village, some fifteen miles north, the river returns to its pre-glacial valley (Fig. 9).

In its middle portion the drainage basin of the Genesee is about forty miles wide. In both its upper and its lower courses the river flows very nearly in the middle of its basin (Fig. 1), but the present Portageville–Mount Morris gorge is some six miles west of the middle. The whole region slopes northward as well as toward the middle of the basin; hence the larger tributaries generally join the river some miles north of their sources.

A very significant fact, and one which will be made use of later, is that from the western divide the surface of the land slopes eastward until the Cashaqua valley is reached, and that this valley lies almost exactly in the middle of the Genesee basin in this portion (Fig. 1). Between the western divide and this valley are three north-south depressions. If these depressions were filled to the level of their bounding ridges we should have a gently-sloping surface extending from the divide on the west to the bottom of the Cashaqua valley. (Fig. 6 shows a cross-section of the region.)

THE PRE-GLACIAL COURSE OF THE GENESEE NORTH OF PORTAGEVILLE. — It has already been explained that the river was diverted from its original course by a great mass of terminal moraine at Portageville (Fig. 2). Here the river swings to the left and enters the rock-walled gorge already mentioned. The old

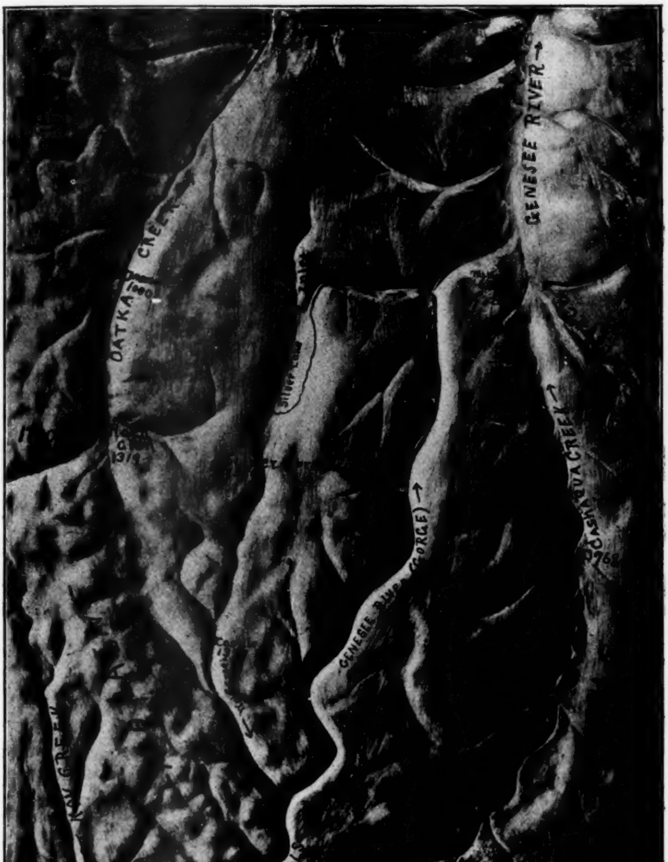


FIG. 2.—RELIEF OF A PORTION OF THE GENESEE DRAINAGE BASIN. MODEL BY R. H. WHITBECK. SCALE ABOUT 3½ MILES TO THE INCH.

valley, buried by the moraine, must necessarily lie on one side or the other of the present gorge. It must, of course, be a valley whose direction, width, depth, and position in the Genesee basin are substantially the same as the direction, width, etc., of the Genesee valley above Portageville, for it is merely a continuation of that valley, partitioned off from it by the mass of moraine. Prof. Chamberlin says: "Probably the buried valley lies to the *east* of the present rock channel." * Prof. Fairchild † is of the opinion that the Cashaqua valley, on the *east*, is the pre-glacial Genesee valley, but says in a personal letter that it is "a new field." Prof. Grabau has written a paper ‡ in which he argues in

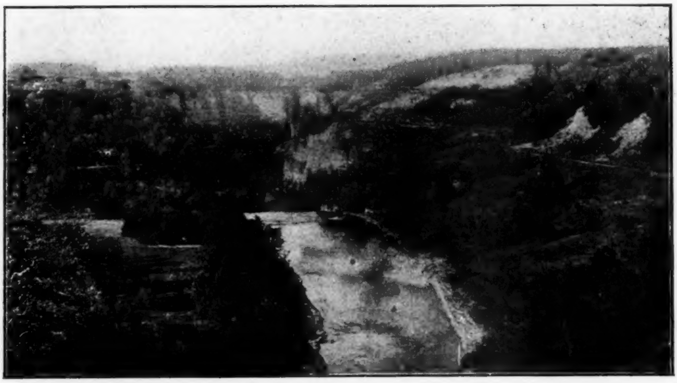


FIG. 3.—UPPER GENESEE GORGE AT MIDDLE FALLS, VIEWED FROM ERIE R.R. BRIDGE (LOOKING NORTH). HERE THE GORGE CUTS ACROSS A LARGE, BURIED, EAST-WEST-VALLEY.

favor of the Oatka valley on the *west*. This paper makes no mention whatever of the Cashaqua valley. Whichever of the two suggested courses is the real one, that course must present the following characteristics:

(1) A pre-glacial valley not less than one mile wide and having a direction, shape, and altitude of bottom substantially the same as the present Genesee valley has at Portageville.

(2) There will be a buried portion of this valley extending northward from Portageville, and merging into it after passing the moraine deposits.

(3) Having been the course of the trunk stream, the valley

* Third Ann. Rept. U. S. G. S., p. 351.

† Bull. Geol. Soc. Amer., 1896, VII.

‡ Proc. Boston Soc. Nat. Hist., 1894, XXXII.

should lie near the middle of the Genesee basin, and toward it there should be a general slope from both sides.

Which of the two valleys, then, the Oatka or the Cashaqua, fulfils these conditions?

Regarding the Oatka Valley.—This valley is best defined at the village of Warsaw. Here the valley bottom, by actual survey, is just two-thirds of a mile in width (Fig. 5). North of Warsaw the valley broadens rapidly, and in less than twenty miles blends into a plain so level as to be selected as a route for several east and west railways. Nor does there appear to be any possibility that this plain is due to the filling of a large pre-glacial

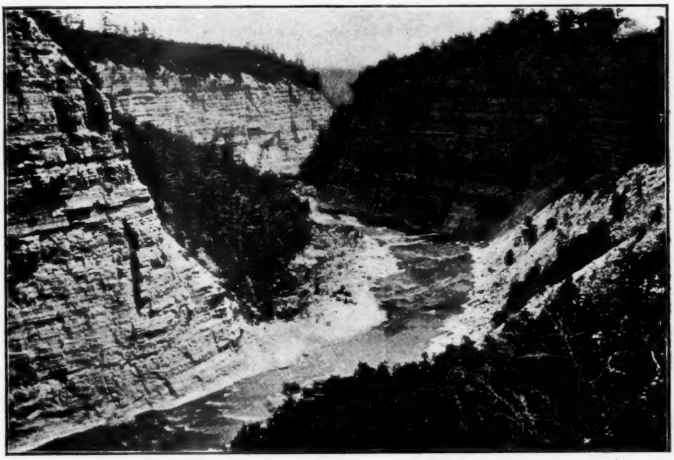


FIG. 4.—GENESEE GORGE BETWEEN MIDDLE AND LOWER FALLS.

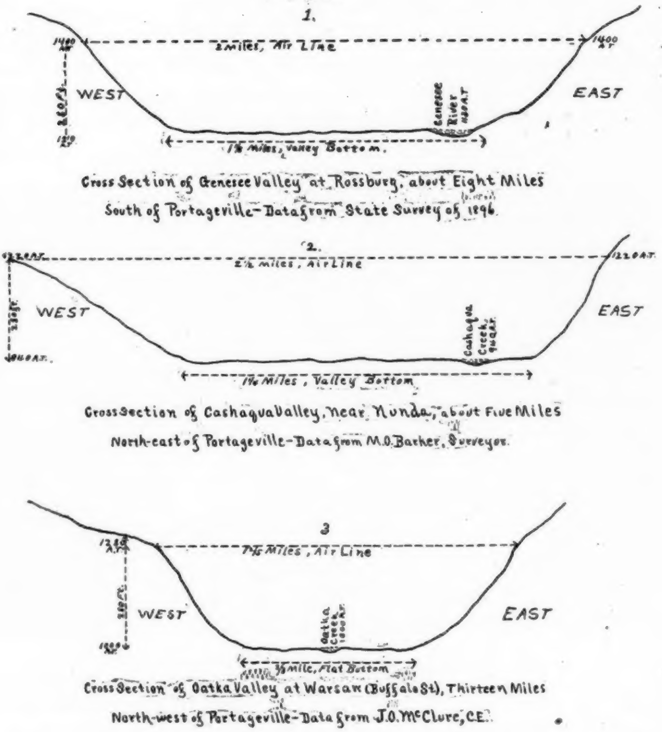
valley, for the region is perforated with salt wells; yet the depth of drift at Wyoming, Pearl Creek, Pavilion, and Leroy nowhere exceeds fifty feet. Beyond Leroy the Oatka flows over a plain with rock everywhere near the surface. The till sheet is very thin, with no moraines to obscure an old valley, if one existed; yet no evidence of any valley at all adequate to have been that of the preglacial Genesee is to be found. So scanty are the glacial deposits in this region that a valley such as the Genesee would have demanded could not exist and remain undiscovered.

So much for the Oatka valley north of Warsaw. For five or six miles south of that village the valley continues, though growing

more and more poorly defined. At Silver Springs it may be said to cease. The hills rise to a considerable height on the western side, but there is only a slight elevation on the east.

From Silver Springs to Portageville, seven miles, there is no valley, either visible or buried, which can be regarded as a connec-

FIG. 5.



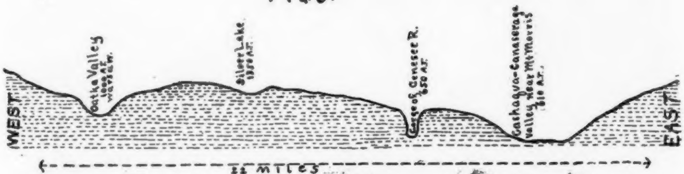
CROSS SECTIONS TENDING TO SHOW THAT 2 MAY PROPERLY BE CONSIDERED A DOWN-STREAM CONTINUATION OF 1, WHILE 3 MAY NOT BE SO CONSIDERED.

tion between the Oatka valley and the Genesee valley. The rock lies near the surface. At Castile a salt-well-boring passes through about fifty feet of drift. This is the deepest deposit known in the Castile depression, while near the middle of the depression Wolf Creek flows on a rock bottom. The rock here has an elevation of over 1,300 feet above tide; while the river bottom at Portageville has an elevation of only 1,100 feet, and the rock is known to be

not less than seventy feet below. There is, then, no evidence of a buried valley which joins the Oatka and the upper Genesee valleys.

Further evidence tending to disqualify the Oatka valley is found in its *elevation* and *position* in the Genesee basin. This portion of the Genesee drainage area is about forty miles in width. The lowest land is in the middle of the basin. The Oatka valley extends along the western margin, its western slope culminating in the Lake Erie divide, and the bottom of the valley in places being only four or five miles from the divide (see Fig. 1). Moreover, *no important tributaries flow toward this valley*, all flowing toward the middle of the basin, which is between three hundred and four hundred feet lower than the Oatka valley bottom. It is scarcely conceiv-

Fig 6.



Section Showing the General Slope from the Western Divide of the Genesee Basin Toward the Cashaqua Valley and away from the Oatka Valley. Latitude 42°-43'

able that the Genesee could have followed a course thirty-five miles from one side of its basin and only five miles from the other side when a much more natural course and much lower land is found through the middle of its drainage basin.

Gathering together these facts, we find: (1) that the Oatka valley, in its best-defined portion, is more than one-third narrower than the Genesee valley above Portageville; (2) that no connecting link between the Oatka valley and the Genesee at Portageville can be traced; (3) that the valley is high up on one side of the Genesee basin, and close to the western divide; and (4) that the general surface of the land slopes, not towards the Oatka valley, but away from it, toward the middle of the Genesee basin.

Regarding the Cashaqua Valley. — From the village of Nunda, a few miles northeast of Portageville, a perfectly-defined pre-glacial valley extends northward, and merges into the broad Genesee valley near Mount Morris (Fig. 2). At the south, this valley ends almost abruptly near Hunts, on account of a vast accu-

mulation of moraine. In the Third Annual Report of the United States Geological Survey, page 352, Chamberlin says: "A few miles east of Portageville the moraine is forced against the high hills that lie south of Hunts and Dalton, and becomes a great irregular terrace banked against them." Again he says: "It is not improbable that the moraine accumulations at the centre of the valley have a depth of five or six hundred feet." A relatively small stream, the Cashaqua Creek, rising in the high hills south of Dalton, flows through the valley. It is at once evident that the pre-glacial representative of the Cashaqua Creek must have been a very much larger stream, and that it rose much farther south; for

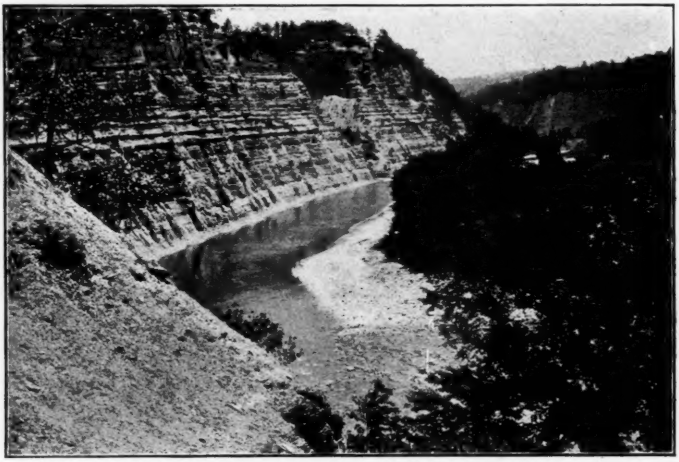


FIG. 7.—GENESEE GORGE BELOW LOWER FALLS. ENTRANCE OF WOLF CREEK AT CENTRE, LEFT.

as soon as the valley at its southern end is clear of moraine it is fully a mile wide, and maintains a width of one mile or more for its entire length. Manifestly this broad depression, with gently sloping sides, does not spring abruptly into existence at Hunts, but is a *continuation of some valley* from which it has been partitioned by the moraine, which here fills it. That it is the continuation of the *Genesee valley* does not seem difficult to establish.

It has already been pointed out that the broad upper Genesee valley is abruptly terminated at Portageville by the moraine, and that no northward continuation of this valley can be traced on the *west* of the present gorge.

Three or four miles to the east, however, we find the Cashaqua

valley beginning almost as abruptly as the Genesee valley ends, and between the two a great mass of terminal moraine several hundred feet in depth. In width and general outline, the Cashaqua valley bears the closest resemblance to the upper Geneses valley. The high hills which form the eastern rim of the upper Genesee valley continue on in an almost unbroken line to form the eastern rim of the Cashaqua valley. That is, the eastern slope of the Genesee and Cashaqua valleys is one continuous range of hills.

From its headwaters to Portageville the Genesee flows very nearly in the middle of its drainage basin. The same is true of the lower Genesee from Mount Morris to Rochester; and it is a fact of significance that the Cashaqua valley for its entire length occupiee

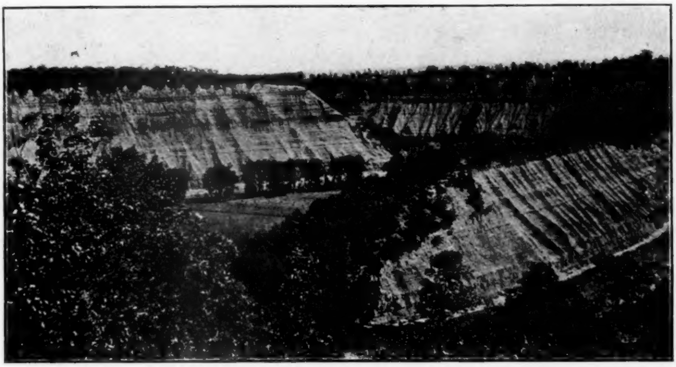


FIG. 8.—SHOWING ONE OF THE GREAT LOOPS, MADE BY THE GENESEE RIVER ABOVE MT. MORRIS. THE ROCK TONGUE AT THE RIGHT IS CALLED THE HOGBACK.

almost the exact middle of the Genesee drainage basin in the very area where the Genesee departs from the median line.

Not alone does the Cashaqua valley lie in the middle of the Genesee basin, but toward it the land slopes all the way from the western divide. A study of the map (Fig. 1) shows that between the Cashaqua valley and the western divide the tributary streams flow eastward. No streams of any importance flow into the Oatka, or into the Silver Lake depression, or into the present Genesee gorge from the east. The cross-section of the basin shown in Figure 6 explains the reason for this—the land slopes constantly eastward toward the Cashaqua valley as though this were the trunk valley of the basin. This is in strongest contrast to the case of the Oatka valley.

Thus, by reason of size, shape, position, and elevation the Cashaqua valley may well be the connecting link between the upper and lower courses of the pre-glacial Genesee. To substantiate this it will be necessary to determine the existence of the buried portion of the valley between Portageville and Hunts. On the Portageville end the buried valley is well shown, and its existence is recognized by all who have written upon the region. Quoting again from Prof. Chamberlin's report, he says on page 351: "To the east the moraine rises in a ridge 425 feet above the flood plain of the river at Portageville."

Here the river has cut into the drift, not only exposing a fresh surface, but also exposing a portion of the western rock wall of the buried valley. The opposite wall, which should be about a mile

FIG. 9.—GENESEE GORGE JUST ABOVE MT. MORRIS. HERE THE RIVER RETURNS TO ITS PRE-GLACIAL VALLEY. THE HILLS IN THE DISTANCE ARE THE EASTERN SLOPE OF THE ANCIENT VALLEY.

and a half up the river, is not visible on account of the forest-covering; but its existence is shown by well-borings in the vicinity, and is revealed by streams flowing down its slope. While the moraine is very deep, yet it does not rise to the level of the hill-tops on the southeast, but forms great irregular terraces against the hillsides. In these terraces deep wells have been drilled. One of the wells nearer the margin of the buried valley reaches the rock at a depth of 70 feet below the surface; another well, one-fourth mile toward the middle of the valley, did not reach rock at a depth of 166 feet, thus showing a slope of the rock bottom in the direction which would be expected on the assumption that a buried valley exists.

Two or three little streams flow down from these high hills into

the Cashaqua valley at Oakland and Nunda, and they tumble along over a very steeply-sloping valley wall of rock, one of them descending nearly 400 feet in a distance of three miles. This deeply-sloping rock wall is plainly the other, or eastern, side of the old valley, whose western slope is revealed at Portageville.

It is a point of some interest in this connection that the engineers who laid out the route for the old Genesee Valley Canal followed the river northward to Portageville; then, passing a short distance along the gorge, turned into the Cashaqua valley and followed it to its junction with the lower Genesee at Mount Morris. Thus, the route which the surveyors found practicable for a canal through the Genesee valley uses the Cashaqua valley as a connecting link between the upper and the lower Genesee valleys. The same line is now followed by a branch of the Pennsylvania Railroad.

That a deeply-buried valley does connect the Upper Genesee valley with the present Cashaqua is, then, a matter of certainty. Throughout its entire length the Cashaqua valley maintains a width and a shape such as would be expected on the assumption that it is a portion of the pre-glacial Genesee valley (Fig. 5). At its northern end it is somewhat clogged with drift, but its general outline is not obscured. Here it unites with the Canaseraga valley, another broad, ancient depression, and their union produces the Lower Genesee valley, into which the Genesee river now enters below Mount Morris after emerging from its post-glacial gorge (Fig. 9).

CONCLUSION: In the Cashaqua valley we have then: (1) a valley whose width, elevation, and direction qualify it to be ranked as a continuation of the Genesee valley; (2) a valley lying in the middle of the Genesee drainage basin; (3) a valley whose connection with the Upper Genesee is positively traceable; (4) a depression toward which the surface has a general slope; (5) the only valley which possesses these characteristics.

Contrasting the seemingly insuperable objections to the Oatka valley with the fitness of the Cashaqua, there can be, as I view the matter, only one conclusion—that the pre-glacial course of the Genesee river north of Portageville was by way of the Cashaqua valley.

BIBLIOGRAPHY.

Bigsby............Am. Jour. Sci., 1820, II, 250–54.
Wadsworth.. ......Same, 1830, XVIII, 209–210.
Silliman...... ....Same, 1830, XVIII, 210–211.
Hall..............Geol. of N. Y., 4th Dist., 1843 { 368–374, 422. / 377–382, 344.

Grabau............Proc. Bost. Soc. Nat. Hist., 1894, XXVI, 359-369.
Davis.............Proc. Bost. Soc. Nat. Hist., XXI, 1882, 361.
Fairchild..........Bull. Geol. Soc. Amer., 1896, VII, 423-452.
Am. Jour. Sci., 1899, VII, 249-263.
Proc. Rochester Acad. Sci., 1900, 180-181.
Proc. Rochester Acad. Sci., 1900, 188.
Tarr..............Bull. Amer. Geog. Soc., Dec., 1898, 383-386.
Chamberlin ....3rd Ann. Report U. S. G. S., 1883, 351.
Dryer.............Am. Geol., V, 1890, 202-207.
Annual Report State Engineer and Surveyor of N. Y., 1896.
Same in Assembly Documents, 1897, Vol. 19, No. 73.
Report of Salt Well Borings. { Map of region, etc., in Bull. No. 16, N. Y. State Museum, Apr. 1893.

NOTES ON CLIMATOLOGY.

BY

ROBERT DeC. WARD.

RAINFALL, COMMERCE, AND POLITICS.—There are all too few studies of the human or economic relations of meteorology and climatology, and for this reason a recent paper by Mr. H. H. Clayton, of Blue Hill Observatory, Hyde Park, Mass., is likely to attract considerable attention. The subject, *The Influence of Rainfall on Commerce and Politics* (Popular Science Monthly, December, 1901), is one which naturally excites the interest of even the casual reader, who often goes no further than the title of a book or of a magazine article, and any one who considers carefully what Mr. Clayton has to say will agree with the author as to the need of more instruction in meteorology in the universities of our country.

After a study of the annual rainfalls and water-levels in the United States from 1830 to 1896, it appears that every severe financial panic has been associated with a protracted period of deficient rainfall, and that there has been only one period of protracted drought without a severe financial panic, and that was the drought whose effects were masked by the larger disturbances attending our Civil War. A severe financial panic in 1837 came in the midst of a drought. Another period of drought culminated in 1855 in the Mississippi valley, and in 1856 in the Ohio valley. The panic of 1857 followed. Another severe drought reached a maximum in the Ohio and Mississippi valleys in 1871, and in the Lake Region in 1872. The panic of 1873 followed. The last drought, which reached its maximum severity in 1895, was associated with the panic of 1893 to 1894, the business depression continuing throughout the interval, 1893 to 1897 inclusive.

It is well known that changes in political parties are closely related to the conditions of prosperity or of depression which prevail at the time. Mr. Clayton points out that a change from a Republican majority of 107 in the House of Representatives to a Democratic majority of 74 was brought about at the first national election after the financial panic of 1874. Political effects following the crisis of 1893 are of so recent a date that they need no comment. Mr. Clayton's paper is certainly extremely suggestive, and we agree entirely with the author when he says:

To designate as a superstition the belief in the capacity of the various political

parties in power to make prosperity may be extreme, but certainly careful thinkers will join in the wish that such relations to natural phenomena as are here outlined might be carefully studied by trained investigators, using well-known scientific methods.

The Health of the Navy in 1900. — The Report of the Surgeon-General of the Navy for 1901 contains some matters of interest in connection with tropical hygiene, and also with regard to the experience of our men when ashore in China during the recent war. The number of cases of typhoid fever (175) was greater that that of the previous year (134), the difference being explained partly by the fact that the disease is very prevalent in the Tropics, and partly on the ground that there was an increase in the enlisted force. The disease was especially prevalent at Guam. Twenty-eight cases occurred there out of a total of 83 cases returned during the year from all shore stations.

Dysentery caused a larger number of admissions than in 1899, 40 cases occurring in Guam, 34 among the force ashore in China, and 33 in Cavite.

Dengue was especially prevalent at Cavite, P. I., nearly all persons on duty there being attacked shortly after their arrival. The attacks were generally mild in type, ending in complete recovery, and usually in immunity from the disease.

Surgeon George A. Lung, medical officer with the first regiment of marines in the Peking relief expedition, gives an interesting account of that expedition. The heat caused great suffering; the thermometer ranged above 100°. Dust, insufficient or bad water, and excessive fatigue also added to the difficulties encountered on the march. Dr. Lung says:

> Nearly everyone lost flesh on the march. In a few cases this was the only symptom that indicated by its pronounced character that the individual was suffering from some form of infection. In connection with the marked emaciation there was a peculiar tendency of the patient to cry. When he applied for treatment, and was asked to describe his symptoms, his lips trembled and tears ran down his face, conscious all the time he was acting ridiculously, but unable to control his emotions. It reminded one of descriptions of the so-called booboo fever said to occur in the Hawaiian Islands.

Annual Report of the Chief of the Weather Bureau.— The Annual Report of the Chief of the Weather Bureau is a publication which always deserves attention, for there is no Department of our Government whose work is more closely connected with the occupations of our people. The last Report for the fiscal year ending June 30, 1901, naturally contains many items which have

already been made known through the medium of the newspapers, but which, nevertheless, deserve to be recalled. During the year a very important extension of the forecast work of the Weather Bureau was undertaken. This consisted in an arrangement with the Meteorological Office in London whereby daily weather reports are now cabled to Washington from that city giving the conditions at certain points in the British Isles and on the continent of Europe, and also from Ponta Delgada, in the Azores. These reports, together with observations made at Nassau, Bermuda, and Turk's Island, are now published regularly on the daily weather maps issued at Washington, Baltimore, Philadelphia, New York, and Boston, together with forecasts of the force and direction of the wind and the state of the weather for the first three days out, in the case of steamers bound east from American ports. In some cases, when severe cyclones were passing to the eastward off the American coast, forecasts of the weather which would probably be met by steamers leaving European ports westward bound were cabled to London. Predictions of fog were also issued when conditions favourable for fog development were indicated on the steamship routes west of the 50th meridian.

The principal storm of the year was the Galveston hurricane of Sept. 8, 1900. Upwards of 6,000 human lives were lost in it, and property to the estimated value of $30,000,000 was destroyed. In order to increase the accuracy of the daily weather forecasts the Chief of the Weather Bureau has announced that

> marked success in forecasting, the invention of new methods of forecasting, or the discovery of new facts or principles of marked value to the forecaster, will have a special weight in considering the merits of employés of whatever grade for promotion.

The cotton region service has been extended into Oklahoma and the Indian Territory; and arrangements have been made with reference to inaugurating a fruit and wheat service in California, to be carried on along similar lines. Nearly 42,000 families in farming districts are now supplied with the latest weather forecasts by means of the rural free mail delivery. Local snow bulletins, issued by the State centres in the Rocky Mountain region, are meeting an important need. Information as to the depth and character of the snowfall in the mountains is contained in these bulletins, and these data are valuable in connection with the summer water supply for purposes of irrigation. Professor F. H. Bigelow has practically completed a revision of the barometric system of the United States, Canada, and the West Indies. Sixty new storm-warning towers have been erected during the year, equipped with improved lan-

terns. Much has been done by the officials of the Weather Bureau to promote the study of meteorology in the schools.

Climatic Conditions along the Panama Canal.—One of the latest contributions to the canal discussion is that of General Henry L. Abbot on *The Present Condition of the Panama Canal* in the Engineering Magazine for January, 1902. Especial emphasis is laid on the climatic conditions along the route of the proposed Panama Canal. The temperature throughout the entire region where an Isthmian canal could be built varies but little during the year from an annual mean of 79°. That the white race cannot do hard manual labour under these conditions of uniform moisture and high temperature is perfectly clear; but the West Indian negroes do not suffer. Therefore here, as elsewhere under similar circumstances, the whites must be the overseers and the blacks must do the work. The first excavations in the virgin soil have been followed by many cases of malarial fever, but experience has shown that when the deeper subsoil is reached there is much less difficulty on this score. The Panama Company's hospital records during the past twenty years demonstrate the fact that there is no reason for apprehending serious trouble from sickness in the future. The question of rainfall is naturally of the greatest importance. On the Gulf coast, at Colon, the mean annual rainfall is about 129 inches; in the interior, about 94 inches; and on the Pacific coast, about 57 inches. Everywhere there is a well-defined dry season of about four months, and this period can be made use of for carrying out any specially difficult engineering works. The heaviest work that is to be done is in the interior, where the precipitation is the smallest.

In Nicaragua, *per contra*, the annual rainfall on the Gulf coast, where the heaviest excavating must be done, is about 250 inches, and there is no dry season. In the interior and on the Pacific coast there is much less rain, and there is a dry season. The rainfall even here, however, seems to be greater than that in the corresponding portions of the Panama district.

GEOGRAPHICAL RECORD.

NORTH AMERICA.

NAVIGATION ON THE TANANA.—The extent of navigation on the Tanana river, the largest affluent of the Yukon, has long been in doubt. Lieut. Allen, who first explored it, floating down the river in a skin boat, said it was not navigable for more than 300 miles, or half the distance from its mouth to its source. Later, Mr. E. H. Wells said he found a good stage of water, and believed steamboats might ascend the river almost to its head. The question seems to have been settled by the steamer *Lavelle Young*, which, as our Vice-Consul at Dawson relates in the "Consular Reports," ascended the river for 310 miles in August last. The steamer, drawing four feet of water and carrying 150 tons of merchandise, started up the river to settle the question whether the upper Tanana might be reached by a boat carrying a considerable quantity of supplies. It was desired, if possible, to reach a point 480 miles up the river, and establish a trading post at the point where the trail from the Copper river to the Klondike crosses the Tanana. With a depth in the channel averaging five to six feet for most of the way, the steamer made 310 miles in three and a half days; but when still 170 miles from her destination she was brought to a stop, ten miles above the lower end of the Bates Rapids, by the shallowing of the river to three and a half feet. The fact, however, that the river for half its length has been proved to be easily navigable for vessels drawing four feet is of geographical and economic importance. Gold indications have been chiefly discovered on the streams emptying into the Tanana, and it was found that four of these affluents, between the mouth of the Tanana and Bates Rapids, are easily navigable by small steamers for from 50 to 100 miles. The party on the steamer reported that the country has every appearance of rich mineral deposits.

SUBSIDENCE OF AMERICAN COASTS.—The Coast and Geodetic Survey has called attention for some years to the very gradual subsidence of a part of the coast-line of the Gulf of Mexico. Mr. J. Crawford, in *The American Geologist*, says there is no question of the fact that the entire American Isthmus from Salinas Bay, in Mexico, to the south side of Darien, is subsiding slowly; while south

of Darien, on the Pacific Ocean side, at least to the Straits of Magellan, there is a corresponding elevation of the land, but much too small annually to be generally noted. There was a time, evidenced by the fiords on the eastern coast of Nicaragua, southern and southwestern Cuba, and western sides of the Antilles, when Nicaragua was a continent extending eastwardly to at least the east side of the Antilles.

THE DANISH WEST INDIES.—The desire of Denmark to sell her three islands in the West Indies is due to the fact that they are no longer profitable to her. The whole trade of her Greenland colony is a monopoly of the Government, the profits being considerable. Iceland is a profitable colony, as its trade is largely in the hands of Danish merchants; but Denmark has derived little profit from her islands in the West Indies since the decline of the sugar industry in St. Croix and the shipping interests of St. Thomas. The islands buy most of the food they do not raise, and the coal they sell to steamships from this country. England sells them most of their cotton goods, and little, except butter, is purchased from Denmark.

The particular advantage this country may expect to derive from the islands is the superiority for a naval station of the harbour of Charlotte Amalie over any port in Porto Rico. The harbour, completely landlocked, is two miles long, a mile and a half wide, and, though much of it is shallow, there is ample anchorage for a large number of vessels. The deep water and other conditions on the east side of the long, narrow island which guards the harbour on the west are very favourable for the building of a dry dock, coal wharves, workshops, and other appurtenances of a naval station. St. Thomas practically has no industries excepting its small shipping interests. Its sugar fields were abandoned when slavery was abolished in 1848, and have never been reoccupied. The island of St. Croix to the south is the most fertile of the three, and modern machinery and modern methods are used by its planters in the production of raw sugar. In this respect they are in advance of the planters in the British islands of the Lesser Antilles, who use the old methods and derive power wholly from windmills.

YELLOW FEVER NO LONGER A SCOURGE IN CUBA.—Warfare was actively waged last year upon the large breeding-places of mosquitoes in Cuba. The result appears to have been most satisfactory. The death rate from yellow fever was greatly reduced, and several

months elapsed without a single death from this disease in Havana —a result never before known in the history of the city. At the beginning of the present year the monthly death rate in that city was smaller than in a number of our large Atlantic coast cities. This is due evidently not only to the war upon the varieties of mosquitoes which carry yellow fever germs, but also to the systematic cleaning of streets, vaults, and harbour and the incessant assault with broom and disinfecting agencies upon all uncleanliness. The good effects of this régime were manifest even at the end of the first year of our occupancy, when the total deaths for the year were only about half those of 1898. Havana is now one of the cleanest cities in the Western world.

Forest Wealth in the Hudson Bay Region.—Mr. Henry O'Sullivan, Inspector of Surveys for Quebec, has summarized the progress of exploration in the forest region between northern Quebec and James Bay in a report printed by the Canadian Government, last year. The forest wealth is, as yet, most available for exploitation. The mouth of the Little Nottawai river is well situated for extensive pulp industries, a special advantage being that water power may be utilized close to tide water. The river has many large lakes and reservoirs, and the water delivery, at an ordinary stage of low water, is estimated at 25,000 cubic feet a second. The whale and other fisheries of the Bay, as well as the mineral indications throughout the entire region and the great timber resources, will doubtless result in railroad communications. Until they are supplied the resources of this region will be of little value.

AFRICA.

The Cape to Cairo Telegraph.—The overland telegraph line that is to connect the north and south coasts of Africa has been completed as far as Ujiji, on the east coast of Lake Tanganyika. Messages may now be sent from Cape Town about 2,500 miles north, or nearly three times the distance between New York City and Chicago. The wire is strung on insulated iron posts sent out from England. The total force at work averages ten white men and about 1,200 negroes. The work is very difficult, as it has been necessary to transport all material by human or animal portage for hundreds of miles; much work is also necessary to prepare the route through jungle and forests for the construction parties. The line will now be pushed northward from Ujiji into British East Africa and down the Nile as far as Fashoda, which is connected by

wire with Khartum and Alexandria. When the work is completed to Fashoda one of the longest telegraph lines in the world will extend from the northern to the southern coasts of Africa.

THE PEOPLE OF UGANDA.—Sir Harry Johnston, in his paper on Uganda, Ruwenzori and the Semliki forest (*The Geographical Journal*, Jan., 1902), says that the poor and untidy huts of the common people do not correspond with the relatively high position which the Baganda occupy in other respects among African peoples. The chiefs, however, erect buildings of reeds, palm trunks, and thatch, which are imposing, and often elegant, in appearance. The Baganda are a carefully-clothed people who are almost more squeamish about any exposure of the person than Europeans. Yet they are a much less moral race than the naked Kavirondo, though Christianity is exercising a decidedly elevating influence on their habits in this respect. This is, perhaps, the only adverse thing that can be said about them, for in other respects they are a most amiable and charming black race. In politeness, quickness of intelligence, and appreciation of beauty they are the Japanese of Africa, and he is convinced that a very great future lies before the Baganda, if they are properly led forward in a wisely-administered British Protectorate.

THE HIGHEST POINT OF AFRICA.—Sir Harry Johnston says in *The Geographical Journal* (Jan., 1902):

> I am personally convinced that the highest point of Ruwenzori is not under 20,000 feet in altitude, and that it will therefore be found to attain the greatest altitude on the continent of Africa. There must be over 20 miles of almost uninterrupted glaciers along the highest part of the ridge, and this under the Equator must presuppose a very considerable altitude. Apart from which, when, after the most arduous climb I have ever experienced, I reached my highest point on the flanks of the snow-range—14,800 feet—the mountain above me seemed a thing I had only begun to climb, and towered, so far as I could estimate, another 6,000 feet into the dark-blue heavens. Permanent snow, however, lies as low as 13,000 feet, which also is the lowest point to which any glacier reaches, so far as my limited investigation extends (*p. 28*) . . .
>
> With the amount of snow and the extent of glaciation in this equatorial region, the maximum of 16,000 feet, suggested for the extreme altitude, is impossibly inadequate. Judging by eye alone (and I have seen the Alps and Himalaya), I should give a minimum of 20,000 feet for the highest point (*foot-note, p. 41*).

Mr. W. H. Wylde, in July last, also ascended above the snow line of Ruwenzori. He and Mr. Ward, like their predecessors, made their way up the Mubuko valley, the real climb beginning on July 8. On the 10th a start was made for the snow, and Mr. Wylde says that he and Mr. Ward ascended 500 feet, by aneroid, beyond the place where Sir Harry Johnston turned back, their highest

point being 15,000. He estimates the highest peak at 19,000 feet at least, and says that though a fully-equipped traveller might reach the summit, the chances would be against success, owing to the trying climatic variations and the intense physical discomforts experienced.

SOCIAL GEOGRAPHY IN THE SAHARA.—The Suf and M'zab oases, in the southern part of Algeria, illustrate the exceptional nature of individual property in these desert regions. The surface of the land is not property, for, in the immense areas covered with sand and crossed in all directions by sand dunes, any one may take as much land as he pleases for the planting of date-palms or the building of a house. Water is not regarded as constituting property, because it extends in comparatively large sheets under the sands and is within the reach of any one who has perseverance enough to tap it for irrigation purposes. The date-palm is alone regarded as private property. There are often four or five proprietors in a single palm grove. One man may own several trees in each of a number of groves. Everybody owns what he plants, and, of course, no one can appropriate the ground in which another has planted a tree; but if a tree dies and its owner does not immediately replace it with another, the first comer is at liberty to plant a tree in that spot. In other words, water and the earth are common and not individual possessions. They cannot be appropriated for private purposes except during the time that they are used for cultivation. No one is permitted to plant a palm within several metres of another tree, nor may any one sink a well within a certain distance of a palm already planted. Thus the peculiarity of the desert surface and the water resources make the tree the initial cause, the limit and the end in view of all individual ownership.—*La Géographie*, Jan., 1902.

GENERAL.

MAPS MARKING THE LINE IN THE SEA WHERE THE LAND BECOMES INVISIBLE.—Dr. L. Henkel has two maps in the December number of *Petermanns Mitteilungen* showing the line in some seas along which the land becomes invisible. One of them shows ten conspicuous mountains, on or near the coasts of Greece and the islands of the Ægean Sea, as centres of circles, the arcs extending over the water being approximately the seaward limit at which these mountains are visible. The other map, showing the entire Mediterranean and the Adriatic, Black, and Azov Seas, indicates in

blue the water areas that are out of sight of land, and in white those from which land is visible. This map makes it evident that the portion of the Mediterranean from which land may be seen is of astonishing extent. Both maps are valuable contributions to the study of the early days of navigation, when the small barks of the mariner rarely ventured out of view of landmarks along the coasts. They help to explain the fact that maritime enterprise received special development in the Mediterranean at the hands of the Phœnicians, Carthaginians, and Greeks.

Some point of land is in plain view from every part of the Adriatic. This is true also of the island-strewn waters of the Ægean. Land may be seen also over the larger part of the Black Sea, owing to the high mountains of the east and south coasts and along the central part of the north coast. On the other hand, most of the surface of the Sea of Azov is out of sight of land, on account of the flatness of the low-lying country adjacent to it.

THE LOST WALDSEEMÜLLER WALL MAPS DISCOVERED.—Professor F. R. von Wieser announces in *Petermanns Mitteilungen* (1891, No. 12) that the two long-lost wall maps of Waldseemüller have been accidentally discovered in the library of Prince Waldburg in Würtemberg. Prof. P. J. Fischer, who is preparing a scientific work on the discoveries of the Norsemen in Greenland, was looking for old Greenland maps in this library when he found the Waldseemüller maps in sheets stowed away in a folio that perhaps had not been opened in many generations. One of them, issued in 1507, is the oldest map on which the name America appears. Waldseemüller published with this map a small explanatory treatise in Latin entitled "Cosmographiæ Introductio," with an appendix containing translations of the letters of Amerigo Vespucci. In this pamphlet, of which a few copies are preserved in libraries of Europe and this country, the author said:

> And the fourth part of the world having been discovered by Americus, it may be called Amerige; that is, the land of Americus, or America.

This suggestion was adopted by geographers generally, the name being first applied to South America, and later extended over the whole of the Western world. On the map found by Dr. Fischer the name America is printed in large letters in South America, just above the Tropic of Capricorn.

Within a few years, however, additional light was shed on the question of the discovery of the mainland; the copy of Waldseemüller's Carta Marina (1516), the second map found by Prof.

Fischer, does not contain the name America. But it was then too late to change the name. The 1,000 copies of the map of 1507 had been scattered all over Europe. The name America was now used by scholars and writers, and was a part of the common speech. The map had fixed the name and it would never be changed.

Prof. von Wieser says of the map of 1507:

> The peculiar importance of this cartographic monument is based far more upon its profound, widespread, and enduring influence upon the development of the true conception of the world's form than upon the circumstance that it was the first map upon which the name America appeared.

Prince Waldburg intends to reproduce these two maps in *facsimile* under the editorship of Prof. Fischer and Dr. von Wieser, who says that the carrying out of the work will not long be delayed.

Death of an Australian Explorer.—Edward John Eyre, the first white man to cross the southern part of the Australian desert, died in England in November last. One of the largest lakes in Australia bears his name. His geographical work ended with his great journey; but the exceptional interest of this event attracted wide attention, and the explorer received the Founder's Medal of the Royal Geographical Society in 1843.

Eyre went to Australia in 1832, when a boy of seventeen, to seek his fortune in sheep-farming. He first engaged in this business in New South Wales, and then in the transportation of sheep from that colony to the newly-opened tracts of South Australia. The exploration of the lower courses of the great Australian rivers and of the regions around the Gulfs of St. Vincent and Spencer had revealed good grazing lands; the colony of South Australia had therefore been founded, and Adelaide was its chief town.

The colonists believed that wide tracts of pasture lands probably existed beyond the inhospitable zone that bounds the Adelaide district on the north and the west. It was Eyre's work that established the fallacy of this view. His first journey was to the north in 1839, where his search for new pasture lands was unsuccessful. A large area of this dry region, however, has since been turned into grazing land by irrigation. He discovered the Flinders mountain range and the long, narrow Torrens lake, whose northern limit he was unable to discern from his point of view. A year later he found that the lake had dried up, this being the first time that the phenomenon of the disappearing and reappearing lakes of Australia was called prominently to attention.

After returning from his second expedition to Lake Torrens, Eyre, with one white companion and a few blacks, set out for the

west in search of pasture lands along the shores of the Great Australian Bight. He travelled for nearly 1,200 miles through a region no white man had yet seen; and he failed to find an acre of grass land on the way. A part of his small force, when half way across the desert, killed Eyre's white comrade and fled, leaving the others to struggle on almost without supplies for 600 miles to King George Sound, where they arrived, after incredible hardships, in the spring of 1841.

ARCTIC EXPEDITIONS.

FOUR EXPEDITIONS—two American, a Norwegian, and a Russian—according to the latest and best information, are now wintering within the Arctic Circle, while a little below it, on the east coast of Greenland, a Danish party awaits spring for scientific work and exploration. Of the expeditions in the field, the first place falls readily to Peary's, now closing the fourth year of absence and isolation. Five years, indeed, have passed since Mr. Peary, upon the Chickering Hall platform of the American Geographical Society, after receiving its Cullum Geographical Medal, promulgated to the Society, and through it to the public, his plan for the attainment of the Pole, and almost four years have gone since he bade good-bye to home and friends on his high and honourable quest. The work which he has already reported, and recorded upon maps, includes extensive explorations in Western Grinnell Land, the discovery of new land-masses to the northwest of Greely Fjord, high peaks on the western, and noble glaciers on the eastern, slope of the divide, and a complete revision of the map of the Hayes Sound-Buchanan Bay country. Later has come the news of his still greater achievement, second only, Sir Clements Markham says, to the attainment of the Pole itself—the rounding of the northern end of the Greenland archipelago in the spring of 1900, and completely delimiting the outlines of that coast so long shrouded in mystery. The last word from Mr. Peary, in the spring of 1900, left him at Fort Conger after an arduous march of three weeks from his headquarters at Etah, at Foulke Fjord. Leaving historic Conger on April 15, with Henson, his coloured man, and a party of five Eskimos, Peary reached Black Horn Cliffs April 24, where two of the natives were sent back; pushed on to Cape Britannia, where two more were dispensed with, and on May 8, about midnight, opened Lockwood and Brainard's "farthest north" cairn on Lockwood Island. Pushing on past Cape Washington, Lockwood's "farthest seen," Peary turned the northern point of Greenland at 83:27, and thence took

his departure directly over the sea-ice for the Pole. Baffled, however, at 83:50, by a disintegrated pack and ominous signs of open water toward the north, he returned to land and pressed eastward and southward, rounding the entire archipelago, coming in sight of the headland which, eight years before, at Independence Bay, he had christened Navy Cliff. Resting dogs and men at the terminal of his advance, he retraced his steps practically along the same route, more than 160 miles beyond the earlier track of any human foot, and by the middle of June was again safely established at Fort Conger, without the loss of a man, illness, or accident worth speaking about. The following months were spent awaiting the arrival of the auxiliary ship, which did not come; in the musk ox hunt for the winter of 1900–01, and in an unsuccessful attempt in April, 1901, to proceed due north from Cape Hecla, the Greenland route having been, by the expedition of the year before, eliminated from the possibilities. On his birthday, May 6, 1901, Mr. Peary reached the *Windward* at Cape Sabine, finding on board his wife and daughter, prisoners in the ice for eight months. The *Erik*, auxiliary for 1901, effected a junction with the *Windward* August 4; and the last word from Peary, August 29, left him in his temporary camp on the south side of Herschel Bay, on the west side of Smith Sound, ten or a dozen miles southwest of his permanent headquarters at Cape Sabine. With the return of light, Peary will proceed along the familiar, well-travelled route of the Smith Sound ice-foot to Fort Conger, passing caches of supplies every 25 miles, and will advance still further along the coast until at Cape Hecla, northern point of the American continent, he will take his final departure from the land. In a general way, the distance of the whole journey from Cape Sabine to the Pole is about 850 statute miles; but the first third is along a route well marked and thoroughly known, so that practically Mr. Peary's task is 500 miles over the sea-ice and return. That he will accomplish this, of course, no man dares predict. Yet there are many circumstances upon which intelligent hope may be based. Eighty tons of walrus flesh, the best dog food in the world, were landed at Cape Sabine by the *Windward* last summer, and a fourth as much more at the Herschel Bay camp by the *Erik*, Mr. Peary's purpose having been to subsist the dogs at the latter place until the supplies there were exhausted and then to take them north to the main depot. His pack at the end of August numbered at least 60 strong, healthy animals, and these will be augmented by the very best of the tribe's when they shall pay their spring visit to the explorer, now becoming as regular an incident in their annual

routine as the return of the light. Unless the dreaded plague should break out among the dogs, as it did in 1894, there seems no reason to doubt that Peary will take the field with an exceptionally strong force. Not only will it be necessary for him to subsist the dogs on the land journey, but when he leaves the coast he must take sufficient stores for the whole task, homeward as well as outward, since there is no reason to expect that game of any sort can be captured upon the ice of the open sea. The disadvantage, however, in subsistence, will, perhaps, be more than made up by the facility of travel; and if conditions are favourable, it is not unreasonable to hope that an average of 20 or 25 miles per day will be maintained, and that when the expedition gets further from the land, ice conditions will improve and the last stages toward the Pole will be easier than the first.

Mr. Peary will take a marine equipment, so that no ordinary leads, such as have been seen, or are likely to be met with, will seriously interrupt his progress. Should the unexpected open sea be found, or the pressure reaches of the paleocrystic ice prove impracticable, detours will, of course, be necessary, which may require longer time, and involve more lines of sledging; but with the supply of food sufficient, there is no reason to doubt that Peary will succeed. Returning southward, it is possible that Peary may seek a new route from Cape Hecla, or, perhaps, more likely, from Fort Conger, taking to the high ice-capped interior, and coming directly down to the westward of Smith Sound on a line nearly parallel with its coast. There is also possibility that if drifting ice should compel, or other circumstances make it desirable, Mr. Peary may cross Lincoln Sea, and, striking the Greenland coast somewhere about Sherard Osborn Fjord, make his way over the ice-cap to the Eskimo settlements on Inglefield Gulf.

The Peary steamer, next summer, will take an early departure for the north in order to reach Cape Sabine, the rendezvous, at the earliest practicable moment, not only that it may have abundant time to take advantage of all favouring sea, ice, and weather conditions, but that all the points on both sides of Smith Sound, Cape Sabine, on the west, Etah, and all the Inglefield Gulf settlements, on the east, may be visited more than once, if necessary, and tidings from Peary, or any of his party, be obtained at the earliest moment. The Peary Arctic Club, a number of his loyal friends, have pledged themselves to the work until it shall be finished. The historic *Windward*, which has already spent two winters in the north in the service, equipped with new boilers and engines, or a chartered

steamer, with Mrs. Peary and Miss Peary on board, and with Capt. Samuel W. Bartlett, her excellent Newfoundland navigator, as master, will make what it is hoped will prove to be her final and successful cruise to the north.

THE BALDWIN-ZIEGLER EXPEDITION is wintering in Franz Josef Land, with its ship, the *America*, formerly the Dundee whaler *Esquimaux*. The auxiliary Norwegian steamer *Frithiof* parted from the *America*, August 13, 1901, in latitude 80 deg. 24 min. north, longitude 55 deg. 52 min. east, leaving an abundantly-equipped and enthusiastic party. The Baldwin company has many appliances, of which the practical value has yet to be demonstrated, among which are balloons, with an automatic releasing device, which are expected to deposit records and reports as they may be impelled by the wind and currents of air, so that it is by no means unlikely that the first information from the Arctic will come from the Baldwin-Ziegler Expedition. When the *Frithiof* left the *America* she was heading to the north seeking to find satisfactory winter quarters, with the general plan that a base of operations would be established upon land at some point whence the expedition for the Pole might depart as early as the light of 1902 should warrant. Baldwin had with him more than 400 Siberian dogs, a few ponies from the same country, and an ample supply of Chicago specially-prepared food for the former, with abundant equipment for all the sledge and field work. Baldwin himself, leader of the expedition, has had a liberal training in Arctic work, having been one of Peary's three companions in his farthest on the inland ice journey of 1894, and of the Wellman Franz Josef Land party in 1898–99. His general theory of field work is practically the same as Peary's, and now that the Greenland route has been eliminated, the contest between the two Americans is almost along identical lines, and will cover a distance nearly equal.

The latest word from Baldwin by the *Frithiof*, from his camp on Alger Island, was: "I fully expect to raise the Stars and Stripes at the North Pole, July 4, 1902." Baldwin had with him forty-one men, of whom seventeen were Americans, the entire crew of the ship being Swedes, with six Russian dog drivers and helpers in the party. Capt. F. J. Johansen, Nansen's comrade in his memorable retreat over the sea-ice and winter in the hut on Franz Josef Land, is in command of the *America*. While the attainment of the Pole is the prime object of the Baldwin-Ziegler Expedition, it expects to do valuable scientific work, and has abundant equipment for that

end. Meteorology, geodesy, and photography are all in the hands of competent specialists, and three skilled physicians will not only attend to the health and sanitation of the party, but will bring valuable physiological data upon the effects of Arctic environment.

Provisions for three years were on the *America*, which, when the *Frithiof* left, was deep in the water, perhaps compelling an early discharge upon the nearest available land of a portion, at least, of the cargo, in order to secure that buoyancy of the ship necessary to her safety and highest efficiency in the ice. Alger Island, upon which the temporary Camp Ziegler was made, is but a small rock, less than a mile in diameter, and hardly available as satisfactory winter quarters.

While the *America* and *Frithiof* were serving the main expedition and transporting its forces and supplies to the Franz Josef Land base, a second auxiliary steamer, the *Belgica*, was dispatched to the east coast of Greenland, where, on Shannon Island, she established a station and deposited supplies, which would be available in case of retreat to the southwestward of the Pole. Thus Mr. Baldwin hopes to have three lines open—one to Franz Josef Land, another to the east coast of Greenland, and a third to the western coast and the native settlements with which he is familiar. The Baldwin-Ziegler project now contemplates an auxiliary steamer from Tromsö or other Norwegian port next summer, when efforts will be made to effect a junction with the *America* and to bring home full reports of the work and experiences of the party.

THE THIRD EXPEDITION now in the field, and concerning whose results little is definitely known, and from which, indeed, nothing has been heard for more than two years, is that of the Norwegian Sverdrup, Nansen's navigator in that same historic *Fram* which first pierced the drifting ice of the Polar basin from east to west. Sverdrup, with Lieut. Baumann as executive officer, entered Smith Sound in the summer of 1898, wintered in Rice Strait, meeting accidentally with Peary and learning of the proximity of the *Windward*, and in August was joined by the Peary steamer *Diana*, which brought home mail and reports. The Peary steamer *Erik*, last summer, could learn only that, from Godhavn, in March a steamer had been seen in Davis Strait heading north, which lent colour to the theory that the *Fram* may still be in Jones Sound endeavoring to work to the westward, and possibly into the undiscovered country, either sea or land, to the northward. That there

is any reasonable ground to expect a high northing by the *Fram*, in the Smith Sound route, does not appear. The situation is of sufficient doubt to cause some anxiety among the promoters of the *Fram* expedition, though they find comfort in the fact that Capt. Sverdrup's last report, in the summer of 1899, was that he had four years' provisions on hand. His surgeon, Dr. Svensen, died during the winter of 1898–99, while the ship was in Rice Strait, but otherwise his entire company, when last seen, in August, 1899, were in excellent physical condition.

Just what Sverdrup's work for the first year was his friends in Norway have not informed the world. There is some reason, however, to believe that they will at an early day do so, as the long-continued absence of the expedition makes everything concerning it of more than ordinary interest. It is but reasonable to agree with Peary's impressions of last summer, that Sverdrup could not have gone north through Smith Sound, attempting, as has sometimes been intimated, to round the northern coast of Greenland, without knowledge of that being gained either by the Eskimos or by the *Windward's* party imprisoned in the ice at Cape Sabine. Sverdrup's intention to enter Jones Sound in the summer of 1899 was well known, and the preponderance of evidence seems to be that he has pursued that course, seeking the country to the north-westward, where so much yet remains to be added to the maps. It is not, perhaps, worth while to speculate too closely upon Capt. Sverdrup's operations, though there seems to be no reason to believe that disaster has befallen him, since his ship is able to withstand extraordinary ice pressure; his supplies were abundant, and if he had been forced to abandon the ship and take to the land, it is hardly conceivable that, with a resolute and well-disciplined force, he would not have extricated himself and reached native settlements, where he could remain in safety and absolute comfort, although much time might elapse before the world would learn the facts. The Christiania friends of Sverdrup will send supplies by the Peary steamer next summer, and an effort will be made, so far as practicable, consistent with the main purpose of the expedition, to effect a junction, and, if assistance is needed, extend it.

THE FOURTH EXPEDITION, from which scientific results of much moment will doubtless come, is that of the Russian Baron, Edward Toll, wintering on Sannikoff Land, 77 deg. 30 min. north, one of the Siberian islands, and at a point farther north than that of the destruction of De Long's *Jeannette*. Baron Toll left St. Petersburg

in the Norwegian whaler *Sarja*, and worked his way eastward through the ice along the general lines of Nordenskiöld's *Vega* voyage. Adverse conditions prevented rounding Cape Chelyuskin, and the winter of 1900–01 was spent in Colin Archer port, discovered and named by Nordenskiöld, on the western side of the Taimyr peninsula. During the winter Nordenskiöld Islands were explored, and a coaling station established at the mouth of the Yenisei, indicating that Baron Toll intends ultimately to return to the westward over his own track, instead of pushing on to the eastward along that of the *Vega*, and emerge from the ice by way of Bering Strait. It was not his intention to attempt to reach the Pole, but rather fully to explore the land-masses to the north of the Siberian coast. With a comrade, it was his purpose to cross the Chelyuskin peninsula, and at the last report, April 16, the entire party were in good health. While Baron Toll is working at Sannikoff Land, a detachment will explore the new Siberian islands, the return of the exhibition to St. Petersburg not being expected before the end of the season of 1902.

THE EXPLORATION OF WEST GREENLAND having been practically completed, Denmark now proposes to perform similar work for the east coast, and to clear up the ignorance in which it has been so long enveloped. The supply steamer last season carried a party headed by the botanist, Ch. Kruse, who expects to explore and map the large fjord, Sermilik, and Angmagsalik, at any rate, so far as they can be conveniently reached from the Danish trading station. At last accounts the supply ships had not returned; but for this reason the prospects of the expedition are believed to be good, indicating that the party has been safely landed, though the ship was unable to free herself from the pack. The work of the winter was to be prosecuted by sledges, and boats were included in the equipment for the survey of the fjords and glaciers as soon as the ice should break up in the spring.

TWO EXPEDITIONS, which have not yet taken definite form, are outlined, one of them with practical certainty. Roald Amundsen, navigator of De Gerlache's *Belgica* in the Antarctic, will, next spring, enter Hudson Bay and establish a location for the definite determination of the North magnetic Pole. Capt. Amundsen, a hardy, young Norwegian navigator, who proved his skill in many critical emergencies in the *Belgica's* cruise, has given months to thorough study and training in the science of magnetism, and will lead a thoroughly and amply prepared expedition. He proposes to

leave Christiania early in 1903 in a Norwegian steam sealer, which he will detain at his headquarters, if circumstances make it necessary, during the entire expedition.

ANOTHER UNDERTAKING is that of the Canadian captain, J. E. Bernier, who proposes to enter the Bering Strait, and, taking the ice further east than Nansen, to drift as far as practicable toward the Pole, and then make, over the ice, the remainder of the distance. At last accounts the Canadian captain was in London seeking to raise the last third of the $150,000 estimated for the cost of the expedition, the greater part having already been pledged by friends in the Dominion. Capt. Bernier proposes to introduce wireless telegraphy, and a system of aluminum tubes, 18 feet tall, filled with condensed provisions, and doing double duty as caches and landmarks. He believes that the ship can be forced to a point within less than 100 miles of the Pole, and that then the remainder of the problem will be easy.

A SWEDISH-FINNISH expedition, led by Lieut. Ekstam and Dr. T. Alén, intends to visit the islands north of Matochkin Shar next summer, for geologic and botanical observations; but the Bauendahl East Greenland expedition appears to have been definitely abandoned.

NOTES ON GEOGRAPHICAL EDUCATION.

BY

RICHARD E. DODGE.

THE PRESENT POSITION OF PHYSIOGRAPHY.—The advance of physiography as a college and university subject has been very rapid during the last few years. Not long ago the subject was included in but four or five of the leading universities of the country, and even in some of these no adequate recognition was given to the subject. Now physiography is considered necessary not only at the larger universities but also at many of the smaller colleges, and the recognition given it is constantly being increased, and college authorities are furnishing laboratory equipment rapidly and gladly. Such an advance is proof positive that the subject has established a permanent place for itself in the college and university curricula, not only because of the value of its content as a pure science subject, but also because it has proved to be a disciplinary subject of equal value with the other earth sciences, and because a knowledge of physiography has been found to be of basal importance for an understanding of other fields of thought.

For several years one of the leading university teachers of sociology has required his students to take a half-year preliminary course in physiography as a basis for sociological work, and, conversely, one of the most satisfactory brief treatises of the relation of man to his physical environment is found in an introductory chapter in a volume devoted to the elements of sociology. At another university a course in physiography in one department, and a course on the influence of the environment in another department, have gone hand in hand.

Within the last year or two the leading students and workers in botany and zoology, who are making a study of animals and plants as related to their environment, have seen the value of a preliminary training in physiography, and now are urging the necessity of such training. Indeed, they are going farther, and are borrowing the ideas, and to some extent the terminology, of physiography, and are applying them in their own fields. They find that there is a life-cycle of plants in any particular region similar to and dependent on the life-cycle of land-forms. Thus the several sciences are co-operating in a way that would never have been suggested a

decade ago, when university physiography was young. A beautiful illustration of the relationship between the two fields was shown recently when the physiographer and the zoologist independently came to the same conclusion as to the former drainage of the Tennessee Valley, by way of the Coosa, to the Gulf of Mexico.

In the study of history, as, for instance, the history of the United States, a knowledge of physiography is especially of value, as all the better teachers of history will emphasize; but the subject has not yet received its due recognition from the historians as a body, probably because the historian has been so long in the habit of doing without it.

The workers in geology, to which subject physiography is so closely related, feel a strong need for better training in physiography. Theoretically, it is natural to expect geology to be closely allied to physiography. Recent advancements in the field have shown, however, that physiography has to be employed in certain of the great economic geological problems of the day. Thus, physiography is now proving its practical as well as its theoretical and cultural value, and it will constantly grow in importance from this standpoint.

A knowledge of the origin and meaning of land-forms would be of especial value to civil engineers; but in this field, again, the subject has not found due recognition. Any topographical surveyor, however, would be better able to bring out the meaning of the topography, and give expression to his map, if he knew the story and problems of the land area he was called upon to map. This has been adequately proved by the experience of the United States Geological Survey, and it can be only a question of time when all the larger and better schools of civil engineering will consider physiography a requisite part of their course of training.

The future of the subject, therefore, seems most encouraging, and the progress made thus far is greater than could have been anticipated. Within the last year physiography has been introduced at the University of Pennsylvania, and has been greatly strengthened at Yale University by the establishment of an associate professorship in the subject. Geography, from the school to the university, is closely related, and any advances at the top must react downwards, just as improved elementary school work must spread upwards and strengthen the cause of physiography in the university. The leaven is now working in both directions, and the outlook for a great advance in all phases of geography teaching in the next decade is stronger than it was at the beginning of the last decade.

THE IMPROVEMENT OF GEOGRAPHY TEACHING IN ELEMENTARY SCHOOLS.—In the last number of the BULLETIN mention was made of the important "Report on Geography of the New England School Superintendents." This report has already accomplished much good within and without New England. In several places the topic of geography teaching in elementary schools is now being warmly discussed, and carefully studied by teachers who are engaged in elementary school work.

The most serious of these conferences that have been planned is perhaps that under the auspices of the New England Conference of Educational Workers. This conference is an association of active teachers in and about Boston, who meet in groups monthly during the school year to discuss pressing problems. The conference has a Committee on General Education, which plans, each year, for the discussion of such educational problems as are of general interest. During the present calendar year geography is to receive special attention, the meetings being held on the fourth Saturday of each month during the school year.

The geography conferences ought to be notable, and certainly the results should be widely disseminated, for each conference is to be led by an author-expert. The committee has been fortunate in securing the services of the best-known authors, whose books are most widely used, perhaps, and hence the meetings ought to be most helpful and important.

Mr. Alexis E. Frye, author of the first of the series of geographies from a modern point of view, spoke in January; Dr. H. S. Tarbell, Superintendent of Schools at Providence, R. I., author of the series of geographies bearing his name, and one of the committee who drew up the report on geography already noted, will speak in February and May; Dr. J. W. Redway, the well-known geographer and joint author of the Natural Series of Geographies, will speak in March and April; and Professor F. M. McMurry, of Teachers College, Columbia University, and joint author of the latest series of geographies—the Tarr & McMurry Series—will probably speak in September and October.

Such conferences are most encouraging, and ought to be very successful in helping to improve geography teaching in elementary schools. It is generally conceded now that geography is the poorest taught of any of the elementary school subjects, and yet it must continually and rapidly improve. The situation in the schools is not discouraging, but encouraging, for the number of teachers who are taking up a special and serious study of geography, either

during the year through series of lectures given at colleges or normal schools, or during the summer at the leading summer schools, is constantly increasing.

BIBLIOGRAPHIES DEVOTED TO GEOGRAPHY TEACHING IN ELEMENTARY SCHOOLS.—A good bibliography devoted to geographic education is a valuable help for all dealing with any of the special or general problems of geography teaching. Our recent better text-books contain excellent lists of references of value to teachers; but the books and periodicals noted are not always easily accessible, as but few libraries can keep such special departments up to date.

The recent Library Bulletin (No. 2), published by Columbia University, and devoted to a list of books on education in the libraries of Columbia University, contains a very good and suggestive, but not complete, bibliography of elementary geography teaching. Seventy-six titles are listed, by English, French, and German authors, most of them of comparatively recent date. Teachers and authors interested in the growth of the so-called "new" method of geography teaching should consult this list.

GEOGRAPHICAL EXHIBITIONS.—The value of a geographical exhibition in arousing an interest in geography is very great, and perhaps not wholly appreciated. We have not yet escaped from a state where ignorance still exists in reference to what geography is. Almost every day one hears some person who is seemingly up to date expressing surprise that there is anything in geography beyond information about products, capes, towns, latitude, and mountain ranges. The geography of a generation ago still persists in the minds of many, and the modern view of geography finds scant support from many of those who would be expected to encourage it most.

An exhibition deals with material things, and thus can do more than a prospectus or a treatise to show people what is of value in geography as it is now understood and taught, not only in the leading universities but also in the better elementary schools.

A little over ten years ago the Brooklyn Institute of Arts and Sciences arranged a geographical exhibition of a very inclusive nature, which did a great amount of good at the time, and which has continued to be of service to the cause to the present day. This exhibition was especially complete in maps, which are still preserved in the Museum for use by all those who desire to consult

them, and set an example and standard that have been of great service.

Three years ago a similar but smaller exhibition was arranged at the Science Museum, Springfield, Mass., and attracted a good deal of attention. This exhibition was particularly good in the lines of models and Government maps, and showed what could be arranged at little expense in these lines.

Model and map makers, Government and State bureaux, publishers and others who are producing geographical apparatus will willingly co-operate, as a rule, in giving such an exhibition, and thus the planning and arranging of an exhibition is a very easy matter. There is every reason, therefore, why a zealous worker in geography should not hesitate to arrange for such an exhibition. It is usually destined to be a success, and is more capable of arousing public interest than almost any other form of geographic work.

The latest successful exhibition was held on December 27–30, 1901, at Des Moines, Iowa, in association with the meeting of the Iowa State Teachers' Association. The exhibition was planned by Professor W. H. Norton, of Cornell College, Mt. Vernon, Iowa, and Mr. A. W. Brett, of the West Des Moines High School.

Especial attention was given to models, which included several of the best from Howell and other publishers. The laboratory of Cornell College gave an exhibition of methods of making models as it has been worked out in the laboratory. One model represented Crater Lake, built of contour planes cut out of cardboard. A model of the Wisconsin drumlin area was made in putty, the vertical height being obtained by steel pegs driven to a given height along basal contour lines. Others of Great Britain, and showing ideal glacial and river conditions, were also shown. The sections devoted to maps, photographs, and lantern-slides were especially full.

The exhibition as a whole was one of the most successful features of the Association meeting, and aroused a great deal of interest. The first of its kind in the State, it was natural to expect that the good effects would be very marked. Word has come to us from several sources as to the value of the exhibition in giving an inspiration to the cause of geography teaching. Professor Norton and Mr. Brett deserve great credit for their enterprise and success, and it is to be hoped that their example may be followed at many other centres.

LABORATORY EQUIPMENT FOR PHYSIOGRAPHY.—Several articles have been published during the last few years giving suggestions

as to the equipment of a school geographical laboratory*; but as yet no particular combination of apparatus has been evolved which might be called a standard equipment to accompany any of the leading text-books in the subject. At present any one equipping a school laboratory consults the leading articles and references and then tries to come in touch with the dealers who have those articles that seem most desirable. The choice of what is best is often a difficult task, as large option is allowed in the lists given. Furthermore, the securing of the materials causes much delay and annoyance, because dealers' addresses are not correctly given, or because the prices mentioned are not the net prices. Thus, for several reasons, teachers at a distance from dealers find the equipping of a laboratory a difficult and time-consuming task.

The time seems to be ripe for some dealer to make a specialty—not of maps or models alone, but of the necessary equipment for a geographical laboratory, not including Government maps. School laboratories are increasing in number constantly, and already there is a demand for just such a geographical dealer as has been noted. Only recently one of the large dealers in maps in New York received a request to furnish specifications for the equipping of a geographical laboratory, and could not do so. Not only was the firm not ready to offer advice as to what the equipment should be, but they further did not know what schools could offer the best suggestions.

Such a condition is deplorable for several reasons. There being no accepted equipment, schools are liable to waste money. A few large, expensive, showy pieces of apparatus, of use, perhaps, but a few times a year, are very seductive, and often are bought instead of a greater supply of less showy articles that are much more generally serviceable. The market is full of good and bad apparatus; and now that the field of secondary school physiography is so clearly mapped out, it would seem to be an appropriate time to make a better stand in the matter of laboratory equipment.

* Davis, The Equipment of a Geographical Laboratory, Jour. Sch. Geog., Vol. II, p. 170, May, 1898; Ward, The Equipment of a Meteorological Laboratory, Jour. Sch. Geog., Vol. III, p. 241, September, 1899; Tarr, The Teacher's Outfit in Physical Geography, School Review, pp. 161 and 193, March and April, 1896; Dryer, Lessons in Physical Geography, Am. Book Co., 1901.

M. FROIDEVAUX'S PARIS LETTER.

PARIS, Jan'y 31, 1902.

It would give a very incomplete idea of the activity displayed by the Geographical Service of the Army to speak only of the maps prepared and published by the officers; these maps are based upon rigorous geodetic performance. The geodetic section of the Science Géographique has accomplished, within a number of years past, under the impulse of Gen. Perrier and his successors, a truly remarkable scientific work.

The old French geodetic network, which serves as the basis of the map of France on a scale of 1:80,000, reposes entirely upon the meridian determined in 1790 by Delambre and Méchain as far as Barcelona, and prolonged by Biot and Arago to the Balearic Isles. Six parallel chains cross this meridian at a right angle and start from it; they are united to each other by three accessory meridians, which form, with the principal meridian and the parallels, the *gridiron* network, the meshes of which are occupied by a *filling-up* triangulation. Seven bases (Melun, Perpignan, Brest, Ensisheim, Bordeaux, Gourbeire, Aix) served for points of separation and of verification for this vast assemblage of triangles with which the geographical engineers at first, and afterwards (since 1831) the officers of the General Staff, covered the soil of France, following the methods of observation and of calculation designed by Delambre.

But while these methods were regarded in France as attaining the farthest limits of perfection, in other countries new methods were applied, thanks to which modern triangulations attained a much greater precision. This was recognised by Capt. Perrier in the course of the operations necessitated by the trigonometrical junction of France and England; and at the same time the Bureau des Longitudes, struck by the inferiority of the French triangulation compared with the new foreign triangulations, called for a revision of the Delambre-Méchain meridian. The determination of a new meridian was undertaken, in 1870, for the purpose of detecting and correcting the uncertainties and the errors which existed in the old network. This meridian, which reaches from the frontier of Spain (where it unites with the Spanish triangulation) to the Pas-de-Calais (where it joins the English and the Belgian network), reposes on a base of departure measured at Villejuif and two bases of verification at Perpignan and Cassel; it has been

verified by astronomical observations of longitude, latitude, and azimuth, as well at its extremities as from degree to degree. In addition, a new determination of the astronomical co-ordinates of the Pantheon was made by establishing in the open country, outside of Paris, far from the tremors and the atmospheric impurities of the capital, four stations, the co-ordinates of which were united with the Pantheon and the Observatory by a special triangulation. This new measurement of meridian was finished in 1896; and work is now proceeding on the re-measurement of those few portions of the chain in which the new meridian has brought errors to light.

At the same time, in preparation for the cadastral survey, the Geographical Service has begun the revision of the French triangulation, which suffices for the needs of the map on the scale of 1:80,000 and even for the work on the map of 1:50,000, but not for operations so precise as the execution of a cadastre.

The maps of Algeria and Tunisia, like that of France, are based upon a fundamental triangulation, forming a gridiron system which is completed by a polygonal triangulation of the first order, and furnishes a solid basis for the filling-up. The fundamental triangulation is composed of two great parallels of nearly 15 degrees (parallels of Algiers and Laghouat) and of four meridians (Méchéria, Laghouat, Biskra, Gabès).

The northern parallel (that of Algiers) extends from the frontier of Morocco, near Nemours, to the extremity of the Cape Bon peninsula in Tunisia, and is united on one side to Spain, on the other to Italy, by a special network of junction, devised and executed by Commandant Perrier. Between Sept. 9 and Oct. 16, 1879, were executed simultaneously on two summits of the Sierra Nevada (Mulahacen, 11,420 feet; and Tética, 6,828 feet), and two summits in Oran (Filhaoussen, 3,740 feet; and M'Sabiah, 1,916 feet), observations which effected the geodetic junction of Spain and Algeria. Similar operations in Italy and Tunisia completed the attachment of the parallel of Algiers to the European geodesy. The southern parallel (that of Laghouat) begins at the frontier of Morocco near Aïn Sefra, and ends on the Mediterranean near Gabès, passing through Géryville, Laghouat, Biskra, and Gafsa. It was in 1889–1895 that this second parallel was completed, corresponding in the main with the limit of the high plateaux, after the measurement of the meridian of France had been prolonged to the Sahara, with its northern extension already made to the Shetland Isles (through Laghouat), and the measurement of the three other meridians of Géryville, Biskra, and Gafsa. The two outer

meridians have been carried still further south; the two inner converge towards Ouargla—that of Laghouat by way of Gardaïa, that of Biskra through Touggourt and the valley of the Oued Rhir (1899–1901). In this way has been established, by an uninterrupted chain of triangles, the greatest meridian arc which has yet been measured, extending from the Shetland Isles to the Desert of Sahara, through England, France, Spain, and Algeria, and across the English Channel and the Mediterranean. From an analogous point of view the Gafsa meridian is very interesting, since it may be considered (through the geodetic union of Sicily and Tunisia) as the prolongation of a great central meridian chain of Europe at an almost equal distance between those of France and Russia.

Eight bases have been established at the points of intersection of the meridians and parallels (Oran, Blidah, Bône, Tunis, Méchéria, Laghouat, Biskra, and Ksar Médenine), and fifteen stations form the astronomical network of verification—six on the northern parallel, six on the southern, and three on as many meridians.

Something must here be said of the measurement of the arc of the meridian at Quito by the party under Commandant Bourgeois. The arc to be measured extends through six degrees, from the south of Colombia to northern Peru; the network, comprising fifty-two stations, will rest upon three bases—one fundamental, in the centre, one in Colombia, and one in Peru. Complete astronomical observations will serve to determine the amplitude of the total arc, as well as to compare the geodetic co-ordinates with the astronomical, and study the form of our earth. Observations will also be made for the measurement of gravity, for the determination of magnetic elements and a geometrical level between the sea and the fundamental base.

There is but little of importance to note in geographical events. The Prince of Monaco has published a summary of his last year's voyage in the *Princesse Alice* along the West African coast to the Cape Verde and the Canary Islands. His scientific harvest was abundant, but the details are not yet accessible.

The recently-formed Oceanographical Society of the Bay of Biscay has accomplished 1,400 soundings in the estuary of the Gironde, and is at work upon the formation of a bathymetrical and lithological map of the estuary and of the submarine sector of the river deposits. Between the mouth of the Gironde and Cape Ortegal the Society has dropped 90 floats to furnish indications of the movement of currents, and has made soundings on the continental platform, off the French coast, with samples of the bottom.

In Africa, Capt. Salesses pushes the construction of the railway from Konakry to Kouroussa, on the Niger. Capt. Moll is at work on a map of the third military territory of the Sudan (scale of 1:2,000,000). Three Commissions have done their work: the Franco-Spanish on the limits of the Rio Muni territory; the Franco-German, on the frontier between the Kamerun and the French Congo; and the Franco-Portuguese, on the boundaries of Cabinda. At Dikoa, in the basin of the Chad, Commandant Destenave has found the remains of the unfortunate Béhagle, hanged by order of Rabah, after his long imprisonment.

In Asia, Mr. Gaston Bordat and M. Gervais-Courtellemont have made an interesting journey in Arabia, Persia, and Asia Minor, and Lieut. Hourst, completing the work of the Père Chevalier on the course of the Yang-tse-Kiang, has ascended the great river from I-Chang to Chungking in the gunboat *Obry*.

M. Largeau has undertaken reconnaissances in Espiritu Santo, in the New Hebrides, and M. Fauchère has gone to South America and the West Indies to study the plants (the coffee-tree, rubber plants, the cacao, tobacco, etc.), and select specimens for introduction into Madagascar.

A number of geographical works must be noticed. The first place belongs to the remarkable volume published by M. Kilian, under the patronage of the French Association for the Advancement of Science, entitled *Observations sur les variations des glaciers et l'enneigement dans les Alpes Dauphinoises.* These observations are due to the impulse given by a very active society of local Alpinists, and may be studied with Prince Roland Bonaparte's recent notes on the glaciers of the Alps and M. Joseph Vallot's work on the movement and the variations of the Mer de Glace.

The last number of the *Bulletin du Comité de l'Afrique Française* publishes the road-book of Commandant Laquière, which gives us the itineraries of the Servière column to Tidikelt, Tuat, and Gurara in 1900 and 1901, with important geographical information on that portion of the desert.

Some recent maps are of interest, such as M. de Flotte de Roqueraire's Hypsometrical Map of Morocco on a scale 1:3,000,000. This map has been made after 3,600 observations of altitudes, more than 1,900 of them unpublished. It brings together, and arranges in their proper relation, all the scattered indications on the relief of the surface of Morocco. Not less valuable is M. Coppolani's Map of the Saharan Mauritania, on a scale of 1:1,000,000. This region, lying between the Wady Draa, on the north, and Senegal

and the Sudan, on the south, has been under the protectorate of France since the end of December, 1899. Not to be overlooked are the two sheets of the interesting map published by Captain Lemaire, the complement, so to speak, of his previous works.

An admirably-illustrated volume on French Indo-China is the second volume of the series, entitled *L'Empire Colonial de la France*, though the text is not of a high order.

An excellent work of information on China and the Chinese is that of Elisée and Onésime Reclus, *L'Empire du Milieu*, an exact and well-ordered book.

Commandant A. de Gerlache brought out with the New Year the story of his voyage in the *Belgica*. It is an interesting volume, full of detail, and at the same time very well written and finely illustrated. By the side of this account, intended for the general public, the scientific reports by specialists in the various branches are issued by the Belgian Government in grand style. Two of these relate to oceanography: one by Thoulet, on the Determination of the Density of Sea-Water; the other by Thoulet and Arctowski, a Report on the Densities of Sea-Water, observed on board the *Belgica*.

A work by M. Vidal de La Blache, *La Rivière Vincent Pinzon*, is a study in the cartography of Guiana. The Swiss Federal Council, as arbitrator in the boundary question between France and Brazil, fixed upon the River Oyapok as the limit. M. de la Blache had previously seen reason to identify the river, known to the Spaniards of the sixteenth century as the Vincent Pinzon, with the Araguary, and he prints his argument as a contribution to science.

The best work yet published on the subject of the colonies is that by Marcel Dubois and Auguste Terrier, under the title, *Un Siècle d'Expansion Coloniale*.

I should reproach myself if I closed this letter without recording the grievous loss sustained by the Société de Géographie in the death of M. Charles Maunoir, its Honorary Secretary for thirty years, and its moving spirit. Much of the vigour and activity of the Society was due to his influence, and his annual Reports on the progress of geography form a remarkable history of the science for the period embraced. Every one who had been brought into relation with M. Maunoir had come to regard him, it is not too much to say, as a personal friend.

HENRI FROIDEVAUX.

ACCESSIONS TO THE LIBRARY.

January–February, 1902.

BY PURCHASE.

Academy, The.—Vols. I.–VI. London, J. Murray, et al., 1869–70–1874. 4to.

Acosta, Gioseffo di.—Historia Naturale e Morale delle Indie. In Venetia, Bernardo Basa, 1596. 4to.

American Book-Prices Current, 1901. Compiled by Luther S. Livingston. New York, Dodd, Mead & Co., 1901. 8vo.

Amherst of Hackney, Lord, and Thomson, Basil (*Editors*).—The Discovery of the Solomon Islands by Alvaro de Mendaña in 1568. London, Hakluyt Society, 1901. 2 vols. 8vo.

Blades, William.—The Enemies of Books. Chicago, A. C. McClurg (1896). 8vo.

Camden's Britannia. Newly translated into English, etc., by Edmund Gibson. London, E. Swalle, 1695. Folio.

Cappelli, Adriano.—Dizionario di Abbreviature Latine ed Italiane. Milano, U. Hoepli, 1899. 8vo.

Carte Topografiche, Idrografiche e Geologiche, ecc. di Roma e Campagna Romana. Roma, Ministero dell' Interno, 1878. Folio.

Claretie, Georges.—De Syracuse à Tripoli. Paris, Librairie Molière (1901). 18mo.

Clark, John Willis.—The Care of Books. Cambridge, University Press, 1901. 8vo.

Cockerell, Douglas.—Bookbinding and the Care of Books. New York, D. Appleton & Co., 1902. 8vo.

Cushing, Frank Hamilton.—Zuñi Folk Tales. New York, G. P. Putnam's Sons, 1901. 8vo.

(Dana, R. H., Jr.)—Two Years Before the Mast. New York, Harper & Bros., 1840. 12mo.

Davies, N. De G.—The Mastaba of Ptahhetep and Akhethetep at Saqqareh. Part II. London, 9th Memoir, Egypt Exploration Fund, 1901. 4to.

Denon (Vivant).—Voyage en Sicile. Paris, Didot l'Aîné, 1788. 8vo.

Droysen, G.—Allgemeiner Historischer Handatlas. Bielefeld und Leipzig, Velhagen und Klasing, 1886. Folio.

Escriche, Joaquin.—Diccionario Razonado de Legislacion y Jurisprudencia. Madrid, A. Bouret é Hijo, 1875. 4to.

Foley, P. K.—American Authors, 1795–1895. Boston, Foley, 1897. 8vo.

Hatton, Frank.—North Borneo: Explorations and Adventures, etc. New York, Scribner & Welford, 1886. 8vo.

Heilprin, Angelo.—Town Geology. Philadelphia, published by the Author, 1885. Square 8vo.

HEILPRIN, LOUIS.—Historical Reference Book. New York, D. Appleton & Co., 1885. 8vo.

HERBERTSON, A. J.—The Distribution of Rainfall over the Land. London, J. Murray, 1901. 8vo.

Historical Magazine and Notes and Queries, H. B. Dawson, 1857–1874–5 (complete). Boston, New York and Morrisania. 23 vols. 4to.

HODGKIN, THOMAS.—The Walls, Gates and Aqueducts of Rome. London, J. Murray, 1899. 8vo.

Hudson River Guide and Tour to the Springs. New York, Colton & Disturnell, 1839. 24mo.

Jewish Encyclopædia, Vol. I. New York, Funk & Wagnalls, 1901. 8vo.

KAERGER, KARL.—Landwirtschaft und Kolonisation im Spanischen Amerika. Leipzig, Duncker & Humblot. 2 vols., 1901. 8vo.

KEANE, A. H.—Central and South America. Vol. II. *Stanford's Compendium of Geography and Travel* (*New Issue*). London, Edward Stanford, 1901. 8vo.

KUHNS, OSCAR.—The German and Swiss Settlements of Colonial Pennsylvania. New York, Henry Holt & Co., 1901. 8vo.

Law relating to India and the East India Company, The. With Notes and Appendix. 2nd Edition. London, 1841. 4to.

Leigh's New Pocket Road-Book for England and Wales. 8th Edition. London, Leigh & Co., 1840. 16mo.

LE ROUX, HUGUES.—Ménélik et Nous. Paris, Librairie Nilsson (1901). 8vo.

LOSSING, B. J.—Pictorial Field-Book of the Revolution. New York, Harper & Bros., 1859. 2 vols. 8vo.

LOSSING, B. J.—Pictorial Field-Book of the War of 1812. New York, Harper & Bros., 1868. 8vo.

LOWTH, G. T.—Around the Kremlin. London, Hurst & Blackett, 1868. 8vo.

LOZÉ, ED.—Les Charbons Britanniques et leur Epuisement. London, David Nutt, 1900. 2 vols. 8vo.

MACKINDER, H. J.—Britain and the British Seas. New York, D. Appleton & Co., 1902. 8vo.

MEAKIN, ANNETTE M. B.—A Ribbon of Iron. Westminster, A. Constable & Co. (1901). 8vo.

MILLER, JOAQUIN.—Life Amongst the Modocs. London, Bentley & Son, 1873. 8vo.

New York, Manual of the Corporation of the City of. 1843–4. D. T. Valentine. New York, W. C. Bryant (1843). 16mo.

O'CALLAGHAN, E. B., *Translator*.—Laws and Ordinances of New Netherland, 1638–1674. Albany, Weed, Parsons & Co., 1868. 8vo.

PAASCH, H.—From Keel to Truck. Marine Dictionary. English–French–German. London, David Nutt, 1901. 8vo.

PARKER, E. H.—China: Her History, Diplomacy, and Commerce. New York, E. P. Dutton & Co., 1901. 8vo.

PETRIE, W. M. FLINDERS.—The Royal Tombs of the Earliest Dynasties. *Extra Plates*. Part II. London, Egypt Exploration Fund, 1901. 4to.

RAQUEZ, A.—Au Pays des Pagodes. Paris, Maisonneuve (1900). 4to.

RAVENSTEIN, E. G. (*Editor*).—The Strange Adventures of Andrew Battell. London, Hakluyt Society, 1901. 8vo.

RECLUS, ÉLISÉE, & RECLUS, ONÉSIME.—L'Empire du Milieu. Paris, Hachette & Cie., 1902. 8vo.

REID, W. MAX.—The Mohawk Valley. New York, G. P. Putnam's Sons, 1901. 8vo.

RICHTHOFEN, FERDINAND FR. VON.—Führer für Forschungsreisende. Hannover, Gebrüder Janecke, 1901. 8vo.

ROUSSELET, LOUIS.—India and its Native Princes. London, Chapman & Hall, 1876. 4to.

SCHURMAN, JACOB GOULD.—Philippine Affairs: A Retrospect and Outlook. New York, Charles Scribner's Sons, 1902. 8vo.

SCROPE, G. POULETT.—Considerations on Volcanos. London, W. Phillips, 1825. 8vo.

SMITH, ARTHUR H.—China in Convulsion. New York, Fleming H. Revell Co., 1901. 2 vols. 8vo.

STOKES, J. LORT.—Discoveries in Australia, 1837–1843. London, T. & W. Boone, 1846. 2 vols. 8vo.

THORNTON, W. T.—On the Gauge for the State Railways of India. London, W. Clowes & Sons, 1873. 8vo.

THWAITES, REUBEN GOLD (*Editor*).—The Jesuit Relations and Allied Documents, Vols. LXXII and LXXIII, Index. Cleveland, The Burrows Brothers Co., 1901. 8vo.

VIDAL DE LA BLACHE, P.—La Rivière Vincent Pinzon: Étude sur la Cartographie de La Guyane. Paris, Félix Alcan, 1902. 8vo.

VIELE, EGBERT L.—The Transval of New York. With map. New York, Johnson & Co., 1880. 16mo.

WALTON, ELIJAH.—The Coast of Norway. London, W. M. Thompson, 1871. Long 4to.

WHO'S WHO, 1902. (54th Year.) London, A. & C. Black, 1902. 8vo.

WORKMAN, F. B., AND WORKMAN, W. H.—In the Ice World of the Himálaya. New York, Cassell & Co. (1900). 8vo.

BY GIFT.

From The American Book Company, New York:

Lessons in Physical Geography, by Charles R. Dryer. N. Y., Am. Book Co., (1901). 12mo.

From S. P. Avery:

Ireland, Industrial and Agricultural: Handbook, Glasgow International Exhibition, 1901, Dublin, E. Ponsonby, 1901, 8vo; Scenes from Every Land, edited by Thomas Lowell Knox, Springfield, Ohio, Mast, Crowell & Kirkpatrick, 1893, obl. 4to; *Publications of the Caxton Club, Chicago,* translations by Melville B. Anderson: Relation of the Discoveries and Voyages of Cavelier de La Salle, 1679 to 1681; Relation of the Discovery of the Mississippi River (Narrative of N. de La Salle); Relation of Henri de Tonty concerning the Explorations of La Salle from 1678 to 1683; Chicago, Caxton Club, 1898–1901. 3 vols., 8vo.

From Oliver G. Barton :

Historical and Statistical Information respecting the History, Condition and Prospects of the Indian Tribes of the United States, &c. By Henry R. Schoolcraft. Philadelphia, 1851–57. 6 vols., 4to.

From Adam & Charles Black, London :

North America : F. D. & A. J. Herbertson (Descriptive Geography from Original Sources). London, 1901. 16mo.

From James S. Dennis, D.D., Author :

Centennial Survey of Foreign Missions. New York, Fleming H. Revell Co., 1902. Obl. 4to.

From Martha Krug Genthe, Author :

Die Kartographie der Meeresströmungen in ihren Beziehungen zur Entwicklung der Meereskunde. *Deutsche Geographische Blätter, Bd. XXIV, Heft 3 u. 4.* Bremen (1901). 8vo.

From Georg & Co., Genève et Bale :

Les Variations de Longueur des Glaciers dans les Régions Arctiques et Boréales, par Charles Rabot. (Extrait des *Archives des sciences physiques et naturelles,* Années 1899 et 1900). Genève et Bale, Georg & Co., 1900. 8vo.

From L. Gilliodts-van-Severen, Author :

Cartulaire de l'Ancien Consulat d'Espagne à Bruges. (2 parts.) Bruges, L. de Plancke, 1901–1902. 8vo.

From B. Herder (publisher) in Freiburg im Breisgau :

Die Entdeckungen der Normannen in Amerika. Von Joh. Fischer, S. J. Freiburg im Breisgau, 1902. 8vo.

From Jules Leclercq, Author :

Le Conflit entre La Russie et La Finlande. (Extrait de *La Revue Générale, août-septembre, 1901*). Bruxelles, 1901. 8vo.

From The Macmillan Company, New York :

The Mastery of the Pacific, by Archibald R. Colquhoun. New York, Macmillan, 1902. 8vo.

From Albert Matthews, Author :

The Topographical Terms Interval and Intervale. Reprinted from The Publications of the Colonial Society of Massachusetts, Vol. VI. Cambridge, John Wilson & Son, 1901. 8vo.

From D. O. Mills, Morris K. Jesup and Chandler Robbins :

Description de l'Égypte, ou Recueil des Observations, &c., pendant l'expédition de l'armée Française. Paris, Imprimerie Impériale et Royale, 1809–1822: Texte, 9 tomes, folio; Atlas, 14 tomes, grand-folio.

From Giuseppe Ricchieri, Author :

Piccolo Annuario Geografico e Statistico. Supplemento al Testo-Atlante Scolastico, ecc., ecc., per l'anno 1900–1901. Bergamo (1901). 8vo.

From Fr. R. v. Wieser, Author :

Die älteste Karte mit dem Namen "America," a. d. J. 1507 und die Carta Marina a. d. J. 1516 des Martin Waldseemüller. (Separatabdruck aus Petermanns Mitteilungen, 47 Band, 1901, xii.)

BOOK NOTICES.

The New Basis of Geography, A Manual for the Preparation of the Teacher. Jacques W. Redway. The Teacher's Professional Library; The Mercantile Company, 1901. Pp. xiv + 228.

Redway's *New Basis of Geography* is an extremely interesting, suggestive, and helpful treatise, devoted to the exposition of the new point of view in geography that has grown in popular favour in the United States in recent years. The author rightly regrets the credence given to the idea of a *new* geography, and shows clearly how the ideas are old and their general acceptance and use only new.

Broadly stated, this interpretation, or "newness," is the mutual relation of geographic environment to political history on the one hand and economic development on the other.

The book is divided into twelve chapters. The first two chapters are devoted to a consideration of the effects of geography upon history in a way to open any receptive mind to some of the geographic principles that have been in operation throughout human history, but which are so frequently overlooked. Chapter III considers, in a brief way, the continual changes of form on the earth's surface, and the classification of forms and drainage from the standpoint of the geographical cycle. The next chapter considers the distribution of life over the world as determined or influenced by topography and climate. Chapters V and VI carry the same ideas further, showing how the environment has influenced commercial development over the world, and especially in the United States. These chapters are the most suggestive and directly helpful of any in the book, and will be of great practical service to any teacher. They are similar in scope and point of view to the well-known chapters in Shaler's *Nature and Man in America*, and equally lead to broad thinking and open-mindedness.

The remaining chapters are devoted to what might be called methods of teaching in a general and special way. The author rightly urges that a teacher should choose the essential details only, and remember that power to seek out and interpret geographical facts is of more value than a knowledge of unrelated details, and that much attention should be given to training in using maps, encyclopedias, and gazetteers. In reference to definitions, the author shows that a pupil may know all about a feature and not be able to

define it, or he may define it and yet omit all consideration of the essentials from a human and broad geographic standpoint.

As a matter of fact, a geographic definition may have two aspects, one of which is abstract and technical, while the other expresses a relation to life and its activities. The former carries but little meaning to the child; the latter, though imperfect, has a very definite educational value. One must bear in mind that the definition is not a part of the science of geography, but of language. It is the art of expression, and an art, moreover, that demands the highest degree of skill. In a way the best definition is the one which the pupil himself constructs. Its value lies in the fact that the teacher may read between the lines to discover whether or not the pupil has the right idea—very crudely and bunglingly expressed, most likely, but fairly correct as to meaning. Nothing but experience and practice will bring accurate and concise expression, and no one can scarcely expect either accuracy or conciseness in immature minds.

The remaining chapters treat of the use of pictures, maps, models, globes, etc., of the course of study and of observational and field work, and finally of the teacher's preparation. These chapters are all practical and full of good sound sense.

The chapter on the needed preparation emphasizes the necessity of broad training in geography for all grammar school teachers, and include an annotated selected list of reference for teachers. It is unfortunate that some of the books included in the reference list are not accurately quoted, and in some cases later editions than those noted exist.

It is foolish, however, to quarrel concerning minor points in a book that is so generally valuable as is Dr. Redway's latest contribution to geography. Every teacher of geography should read the book with care; but it should be noted that any teacher needs to know much geography in order to get the best out of the book. In other words, it is not a book " for the preparation of the teacher," as it is entitled, but a valuable book for the fairly well-prepared teacher, and particularly for those in the harness of daily teaching geography. R. E. D.

Lessons in Physical Geography, by Charles R. Dryer. American Book Company, N. Y., 1901. Pp. 430, with 347 figures in the text, and several maps.

Modern secondary texts in physical geography must be judged from several standpoints: as to their practicability under existing conditions in secondary schools; as to their scientific accuracy and their value in laying a strong scientific basis in physical geography, on which later work may be founded; and associated with this second point, as to their value for meeting the requirements for college entrance. Whatever the standpoint from which written, the

book must be agreeable reading, must be helpfully illustrated with pertinent figures and plates that are well reproduced, and must be spaced in such a way that the several topics receive their due amount of attention.

In some ways Dr. Dryer's *Lessons in Physical Geography* meets the requirements mentioned remarkably well, and in some ways the book leaves much to be desired. The book is written inductively, and is well spaced, the order followed being one that any teacher could follow without embarrassment. The book covers the four divisions of the subject approved by the Sub-Committee on Physical Geography of the Committee on College Entrance Requirements of the National Educational Association, with a summary chapter on Life, treating the distribution of life largely from the standpoint of relation to the environment. Perhaps the most commendable and useful feature of the book is the series of Practical Exercises, giving suggestions for individual work on the part of the pupils. Some of these exercises are eminently original, and most of them are very practical, even for those schools where opportunities for field work are necessarily limited. Practical as the book is in general plan and in certain details, it is disappointing to find that the author has not distanced his rivals in making a book especially available for the first two high school years, for the reason that it must evidently be many years before the subject can appropriately be included in the last years of most secondary schools.

From the standpoint of the beginning secondary pupil the book is, on the whole, not successful. The text is not sufficiently clear and simple in its treatment, and terminology is too apparent. Dr. Dryer has reduced the number of terms found in some physical geographies, but he has substituted new ones that are of doubtful value or need. *Mantle rock* is not an appealing substitute for waste or detritus, and the beginner does not need either *centrosphere*, *lithosphere*, *biosphere*, or *psychosphere*, to give a few instances. Our texts are too full of terminology, as indeed is, perhaps, the science as a whole.

The book can in general be relied on as being accurate as to principle and fact—a very strong point, in which it surpasses most of the other books in the field. There are a few slips and a few questionable facts; but they are in the minority, In discussing drainage the author uses the term "rejuvenation" to apply to streams that have been increased in power by elevation and to land surfaces that have been refaced by accumulations such as glacial drift; when, from the standpoint of drainage, the effects in the two

instances are strongly contrasted. *Drift* is applied to all transported detritus, when in general usage it is applied to glacial accumulations only. A *consequent* stream is said to become a *subsequent* stream when it has become *adjusted*, making *subsequent* and *adjusted* synonymous, which is contrary to priority and usage. Filled valleys are called *alluvial plains*, when the slopes and the method of origin are strikingly different.

The author has evidently avoided purposely certain fundamental terms in physiography, such as *monadnocks* and *peneplain*. *Relict mountains*, which is not an inviting substitute, is given apparently in place of monadnock, and *peneplain* is used to apply to an old plain only, when it is generally used to apply to all old landforms, and notwithstanding the fact that it was first used to apply to old mountains. The problem of terminology for secondary physical geography is still unsolved.

It would seem rational to include the terms most used in the literature of the subject and to present them in such a way that the student would gain from his study the power of interpreting the literature; but thus far terms have been too many, too few, or not carefully used.

It should be strongly emphasized, however, that the life side of the book is unusually well done. In fact it would be hard to improve upon it. The illustrations are well chosen, pertinent to the text, and unusually well reproduced. From this standpoint the book seems to the present reviewer the best in the field. Another aspect of the book that deserves strong commendation is the series of Appendices, devoted to the Equipment of a Geographical Laboratory; Meteorological Instruments and their Use; The Construction of a Weather Map; and Reference Books. The book closes with an excellent and inclusive index. Teachers will find the list of reference books particularly helpful, because not over-inclusive, but judiciously and scientifically chosen.

As a whole, the book is a strong competitor in the field it occupies; but there is plenty of room for improvement. The book is interesting from the method of presentation adopted, and valuable because it emphasizes in a practical way the possibilities and problems of laboratory work. The author has avowedly written for the teacher as well as the pupil, and perhaps some of the deficiencies of the book may be traced to that cause. The history of the last ten years in elementary and secondary geography has shown conclusively, it would seem, that it is inadvisable to attempt such a contrasted task in one text.

R. E. D.

NOTES AND NEWS.

THE NEXT MEETING of the Society will be held at Mendelssohn Hall, No. 119 West Fortieth Street, on the 18th of March, at 8.30 o'clock P.M. At this meeting M. Hugues Le Roux will describe (in French) the incidents of his Visit to the Emperor Menelik, of Abyssinia.

On the 15th of April, Mr. Carl Lumholtz will address the Society on the Huichol Indians of Mexico.

THE TRANSACTIONS AND PROCEEDINGS of the Geographical Society of the Pacific, Vol. I., Series II., contains a paper by Prof. Davidson on the Tracks and Landfalls of Bering and Chirikof on the Northwest Coast of America, June–October, 1741. The paper is illustrated by a large chart, showing the course of the explorers as laid down by Prof. Davidson from his examination of the authorities.

An idea of the labour involved may be gained by the different positions assigned to Bering's first anchorage under Kayak Island.

Cook, in 1778, placed Beering's Bay, as he called it, at the present Yakutat Bay, 150 nautical miles to the eastward of the true position.

In 1786 La Pérouse fixed it at the mouth of the Allsegh' River, where there is no bay and no anchorage, and seven degrees too far to the east.

In 1787 Portlock and Dixon found Beering's Bay east of what is now Yakutat Bay.

In 1792 the chart of the schooners *Sutil* and *Mexicana* places Bering's anchorage at the Allsegh' River.

In 1794 Vancouver followed Cook in fixing Bering's Bay at Yakutat.

A Spanish MS. in Prof. Davidson's hands describes an exploration of the northwest coast made in 1779 by the frigates *Princesa* and *Favorita*, and assigns its true position to Bering's anchorage at Kayak Island.

THE PHYSICAL GEOGRAPHY of the Texas Region, by Robert T. Hill, is the title of a Folio recently issued by the U. S. Geological Survey.

A map on a scale of 25 miles to an inch shows the county boundary lines and many of the towns, and includes parts of New Mexico, Indian Territory, and Oklahoma.

THE TOPOGRAPHIC SURVEY of Ohio by the State, in co-operation with the U. S. Geological Survey, was begun in March, 1901. By the close of the season in November, 4,370 square miles had been mapped and over an additional area of 14,000 square miles points had been located by primary triangulation and traverse. The map of the State, when finished, will comprise 200 atlas sheets, each representing about 230 square miles, on a scale of about one mile to an inch.

THE STATE OF COLORADO is now engaged in the preliminary work of construction of a six-mile tunnel to carry the water of the Gunnison River to the arid lands of the Uncompahgre Valley.

The exploration of the cañon of the Gunnison, 2,000 feet in depth, was successfully carrried out by Mr. A. L. Fellows and one companion, who traversed the cañon from end to end over falls and rapids, and at the cost of great hardship and danger emerged at last into the upper air, having lost, it seems, nothing but the companion's name.

THE U. S. GEOLOGICAL SURVEY has been asked to make an investigation into the causes of the decline in the level of the Great Salt Lake.

TRANSCRIPTION OF CHINESE GEOGRAPHICAL NAMES.—M. Charles Rabot notes, in *La Géographie*, January 15, the adoption by the Ministry of Foreign Affairs of an established form for the transcription of Chinese words and names in documents published under its authority.

The tables, prepared by M. Vissière, secretary and interpreter, and printed at Angers in 1901, give, according to the Peking pronunciation:

1—the names of the principal rivers and streams;

2—the administrative subdivisions of the provinces of Chili and Manchuria, comprising the sub-prefectures (*kien*);

3—all the first-class prefectures (*fu*), secondary (*t'ing*) and second-class prefectures (*chu*), which depend directly on each of the other provincial governments;

4—a number of other important localities, such as the open ports;
5—the names of persons taking part in contemporary affairs;
6—a list of syllables of the Peking Mandarin tongue.

This official transcription will be followed henceforth by *La Géographie*, without raising the question whether M. Vissière's method is good or bad. Experience shows that in this matter unanimity is not to be hoped for, and M. Rabot rightly concludes that, in order to remedy the existing confusion, it is well to follow an effort in the direction of order.

TRANSACTIONS OF THE SOCIETY.

JANUARY–FEBRUARY, 1902.

The Annual Meeting of the Society was held at Mendelssohn Hall, No. 119 West Fortieth Street, on Tuesday, January 21, 1902, at 8.30 o'clock P.M.

Vice-President Moore in the chair.

The following persons, recommended by the Council, were elected Fellows:

Charles S. Penwarden. David W. Fairleigh.

The Annual Report of the Council was then submitted and read:

NEW YORK, January 9, 1902.

To the American Geographical Society:

The Council respectfully submit the following report for the year 1901:

The number of Fellows on the 1st of January was 1,120. The additions during the year number 165. The losses by death, resignation, etc., were 79, and the total Fellowship on the 31st of December was 1,206, of which number 324 were Life Fellows.

The additions to the Library number 3,234: Periodicals and Pamphlets, 2,428; Books, 581; Maps and Charts, 213, and Atlases, 12.

Six meetings of the Society were held in the year:

On the 22nd of January Dr. A. F. Schauffler delivered a lecture on Constantinople;

February 20th, Dr. George F. Becker addressed the Society on the Conditions Requisite to our Success in the Philippine Islands;

March 19, Mr. H. M. Wilson delivered a lecture on Examples of Topographic Forms in the United States;

Aprll 16, Prof. Charles L. Bristol spoke on the Geography of Bermuda;

November 19, Mr. Herbert L. Bridgman described Peary's Progress to the Pole;

December 17, Capt. J. Slocum told the story of his Sailing Alone Around the World.

There have been published in the BULLETIN, besides the Record and Scientific Notes and Letters, twenty-two original papers. It has been decided that the bound volume of the BULLETINS shall be known hereafter as the BULLETIN, and that the title of JOURNAL shall be discontinued.

The following contributions to the Building Fund have been received:

From C. P. Huntington	$1,000 00
" W. J. Bormay	15 00
" Miss Luella A. Owen	200 00
	$1,215 00

For the condition of the finances reference is respectfully made to the report of the Treasurer, herewith submitted.

In the summer the new building in Eighty-first street was so far advanced toward completion that the removal of the Society's library and collections was begun and successfully accomplished within a few weeks. The building is not yet in complete

order, but the rearrangement of the library and the map-room is in progress, and the Council feel that the Society is to be congratulated on the possession of a home, admirably situated and well designed for the comfort and convenience of readers and of students.

All of which is respectfully submitted.

HENRY PARISH,
Chairman.

LEVI HOLBROOK,
Secretary.

The Report of the Treasurer was then read:

To the American Geographical Society:

The Treasurer respectfully reports that on January 1st there was on hand a cash balance of		$24,690 33
During the year there has been received for Fellowship dues, Sales of Publications and Interest on investments		16,845 00
Legacies and Donations		43,611 43
		$85,146 76
There have been expended for Salaries, Library, Publications, Meetings, House Account, Insurance, Postages, Expense of Moving, Furnishing, etc.	$15,094 75	
On a/c New Building	53,091 66	
Invested	6,500 00	
		74,686 41
On Dec. 31 there are in bank		$10,460 35

(Signed) W. R. T. JONES,
Treasurer.

The Committee charged with the duty of selecting candidates for the offices to be filled made the following Report:

NEW YORK, Jan'y 9, 1902.

To the Council of the American Geographical Society:

The Committee appointed to recommend to the Society suitable persons to be elected in January, 1902, to fill vacancies then occurring in its offices, respectfully report that they would recommend the election of the following-named persons to the offices below designated:

For Vice-President—C. C. TIFFANY, D.D.,
Term to expire in January, 1905.

For Treasurer—WALTER R. T. JONES,
Term to expire in January, 1903.

For Domestic Corresponding Secretary—CHANDLER ROBBINS,
Term to expire in January, 1905.

For Councillors—WILLIAM G. HAMILTON,
HENRY HOLT,
CHARLES S. FAIRCHILD,
HERMAN VON POST,
GEORGE S. BOWDOIN,
Terms to expire in January, 1905.

Respectfully submitted.

(Signed) HENRY PARISH,
" FRANCIS M. BACON,
" CHANDLER ROBBINS,
Committee.

On motion duly seconded, Mr. A. A. Raven was appointed to cast the vote of the Society for the candidates, and they were declared duly elected.

The Chairman then introduced the speaker of the evening, Mr. Alden Sampson, who addressed the Society on A Visit to Palmyra. Illustrations were shown on the screen.

On motion, the Society adjourned.

A Regular Meeting of the Society was held at Mendelssohn Hall, No. 119 West Fortieth Street, on Tuesday, February 18, 1902, at 8.30 o'clock, P. M.

Vice-President Tiffany in the chair.

The following persons, recommended by the Council, were elected Fellows:

James E. Chandler.	Ernest R. Ackerman.
A. S. Frissell.	A. Van Rensselaer.
C. R. Corning.	Henry W. Jessup.
George C. Sawyer.	

Prof. Thomas C. Mendenhall was elected an Honorary Member.

The Chairman then introduced the speaker of the evening, Prof. Richard E. Dodge, who delivered a lecture on Life Conditions in a Desert, with special reference to the South-western United States. The lecture was illustrated by stereopticon views.

On motion, the Society adjourned.